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1. ABSTRACT (Continue on reverse if necessary and identify by block number) This report is the third for this waste reduction project. It summarizes the results of the project, presents reviews of the workshops, and provides a source of materials prepared for the workshops in the appendices. This report concentrates on the Projects of Excellence. The three cases selected as Projects of Excellence were: - Plastic Media Paint Stripping at Hill Air Force Base, Ogden, Utah - Innovative Hard Chrome Plating at Pensacola Naval Air Rework Facility, Pensacola, Florida - Centralized Vehicle Washracks and Scheduled Maintenance Facilities at Fort Lewis Army Post, Tacoma, Washington			
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INDUSTRIAL PROCESSES TO REDUCE GENERATION OF HAZARDOUS WASTE AT DOD FACILITIES

appended to the

PHASE 3 REPORT

project is being to

APPENDIX A - WORKSHOP MANUAL

The waste is located
Plastic Media Paint Stripping
Hill Air Force Base, Ogden, Utah ←



prepared for the
DOD ENVIRONMENTAL LEADERSHIP PROJECT
Washington, D.C.

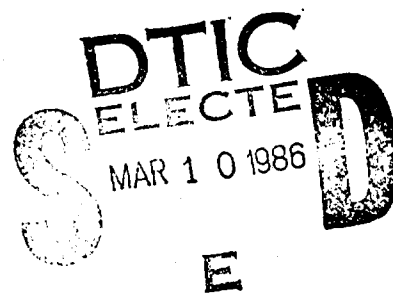


and
U.S. ARMY CORPS OF ENGINEERS
Huntsville, Alabama

CHM HILL

and

PEER CONSULTANTS, Inc.



December 1985

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This report was prepared by CH2M HILL, Inc., Reston, Virginia, and PEER Consultants, Inc., Rockville, Maryland, under Contract Number DAC A87-84-C-0076, dated August 17, 1984, for the DOD Environmental Leadership Project (DELP) and the U.S. Army Corps of Engineers (COE). CH2M HILL was the prime contractor. PEER was responsible for the preparation and presentation of training workshops at the sites of the Projects of Excellence. Dr. Richard Boubel was the Project Officer for DELP, and Mr. Stan Lee was the COE Project Officer. Dr. Thomas E. Higgins was Project Manager for CH2M HILL, and Dr. Brian P. J. Higgins was Project Manager for PEER. Major contributions were made to this project by Drew P. Desher, Randall Peterson, R. Benson Fergus, J. Kendall Cable, Thomas R. Card, Brian R. Marshall, Daniel Bostrom, and Reid Dennis, of CH2M HILL, and Mary Savage of PEER.

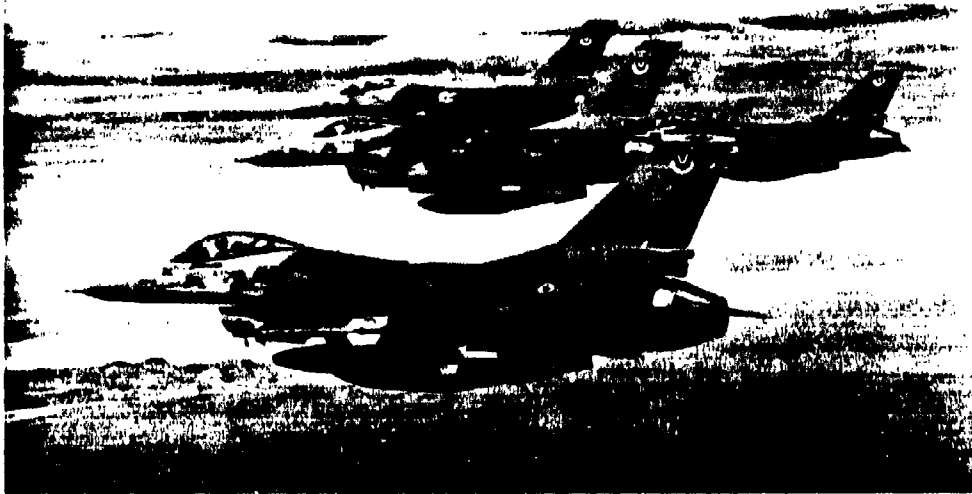
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HILL AIR FORCE BASE

"Home of the Fighting Falcon"



HILL AIR FORCE BASE "Home of the Fighting Falcon"

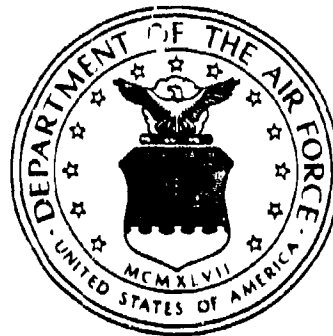
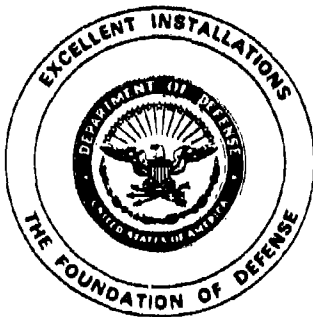
The F-16 flies high over Utah in support of the mission of the 388th Tactical Fighter Wing at Hill AFB, Utah. Pilots of the USAF train in the multi-role fighter in the desert area west of the Great Salt Lake. The aircraft is manufactured by General Dynamics of Fort Worth, Texas.

THE FIGHTING FALCON

The 388th Tactical Fighter Wing flies the General Dynamics F-16, the Air Force's newest multi-role combat fighter. The F-16 is a single engine, light weight, high performance aircraft powered by a 25,000 pound thrust class Pratt & Whitney F-100 afterburning turbo-fan engine. The aircraft has the capability to fly at twice the speed of sound (speed of sound is 720 MPH at sea level). The World-Wide F-16 Program is managed by the Ogden Air Logistic Center at Hill Air Force Base, Utah.



PROJECT OF EXCELLENCE
PLASTIC MEDIA PAINT STRIPPING
OGDEN AIR LOGISTICS CENTER
HILL AIR FORCE BASE, UTAH



PHASE 3 WORKSHOP:
INDUSTRIAL PROCESSES TO REDUCE GENERATION OF HAZARDOUS WASTE
AT DOD FACILITIES

Prepared for the
DEPARTMENT OF DEFENSE ENVIRONMENTAL LEADERSHIP PROJECT
WASHINGTON, DC
and
U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

Contract DAC A87-84-C-0076

By
CH2M HILL
RESTON, VIRGINIA
and
PEER CONSULTANTS, INC.
ROCKVILLE, MARYLAND

CONTENTS

Agenda

Workshop Response Survey

Participants

Participating Organizations

Workshop Location Maps

1.0 Introduction

2.0 Project Description

3.0 Alternative Process Modifications

4.0 Project Requirements

5.0 Production Benefits

6.0 Occupational and Environmental Benefits

7.0 Demonstrations and Tours

Bibliography

Appendix

- 1.0 Policy Documents Concerning DoD Hazardous Waste
- 2.0 Selected Project References
- 3.0 Manufacturers' Literature

DISCLAIMER

Mention of specific items of equipment, trade names, consultants, or industries does not constitute an endorsement by the U.S. Department of Defense. Names and addresses are provided only as a convenience for readers of these workshop materials.

AGENDA

Tuesday, August 13, 1985

Location: VIP Area Conference Room, Building 225 (Main Hanger), Hill AFB

8:15 AM Welcome: BG Harold N. Campbell, Vice Commander, Ogden Air Logistics Center

8:30 AM Introduction

Moderator: Brian Higgins, PEER Consultants

Participants introduce themselves - name, organization, and responsibilities

9:00 AM Projects of Excellence Background and Purpose

Speakers: Richard Boubel, Defense Environmental Leadership Project

Thomas Higgins, CH2M HILL

Coffee Break

10:00 AM Paint Stripping Project Description

Speaker: Bob Roberts, Project Developer

Videotape: Plastic Blasting Versus Chemical Paint Removal (U.S. Air Force, 1984, 8 minutes)

11:15 AM Occupational Safety and Health Concerns

Speaker: LTC M.G. Moody, Staff Bioenvironmental Engineer, Hill AFB

11:30 AM Corrosion and Metallurgical Considerations

Speaker: Allen Budge, Corrosion Control Chemist, Hill AFB

12:00 PM Lunch Break

1:15 PM Videotape: Plastic Blasting Versus Chemical Paint Removal (U.S. Technology Corp., 1985, 15 minutes)

AGENDA (Continued)

Tuesday, August 13, 1985 (Continued)

1:30 PM Tour and Demonstration of Paint Stripping Facilities

Hanger 236, Clemco Blast Equipment and Glove Box
Building 220, Chemical Paint Stripping
Building 223, F-4 Blast Booth
Solvent and Waste Solvent Storage Area
Building 220, Breathing Air Filters

4:30 PM Adjourn for the Day

Wednesday, August 14, 1985

Location: VIP Area Conference Room, Building 225

8:30 AM Report of Hands-on Demonstration

Speakers: Bill Cain, Chemical Engineer, Oklahoma City ALC
Vicki Singleton, Materials Engineer, Air Force Storage
and Disposition Center, Davis-Monthan AFB

8:45 AM Project Requirements and Implementation

Speaker: Bob Roberts, Project Developer

Coffee Break

9:45 AM Project Overview and Production Benefits

Speaker: Brian Higgins, PEER Consultants

Discussion: All Participants

10:45 AM Impacts on the Industrial Wastewater Treatment Plant

Speaker: Allan Dalpiaz, Environmental Coordinator, Base Civil
Engineering, Hill AFB

AGENDA (Continued)

Wednesday, August 14, 1985 (Continued)

11:15 AM PRAM Program

Speaker: Ken Vincent, PRAM Program Officer, Air Logistics Command,
Wright-Patterson AFB

11:45 AM Occupational Safety and Health Progress in Aircraft Paint Stripping

Speaker: Samuel Vigil, Industrial Hygienist, Hill AFB

12:30 PM Lunch Break

1:15 PM Videotape: Centralized Vehicle Wash Racks and Scheduled
Maintenance Facilities (U.S. Army Construction Engineering
Research Laboratory, 1984, 15 minutes)

1:30 PM Project Funding and Future Directions

Speaker: Richard Boubel, DELP

2:00 PM Hands-on Demonstration of Plastic Media Paint Stripping

Schmidt Blast Machine and Vacuum Nozzle
Paint Removal from Carbon Graphite

3:00 PM Tour of Metallurgical and Non-Destructive Testing Laboratory

Plastic Blasting Test Specimens
Surface Penetrant Testing
Eddy Current Testing

4:30 PM Workshop Adjourned

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
AUGUST 13-14, 1985

WORKSHOP RESPONSE SURVEY (tear out)

Why did you come to the workshop - what did you hope to learn?

Which parts of the program were of most interest to you?

What additional topics should have been covered?

What problems do you foresee in developing the capability for plastic media paint stripping at your installation?

Are there other process modifications with the potential to improve productivity and/or reduce waste generation which you hope to see implemented?

What methods of information/technology transfer do you think would have the greatest chance for success in helping to spread process improvements and new technologies?

Other Comments (Continue on Back)

Name _____
Organization _____

Phone _____

Please Return to:
Brian Higgins
PEER Consultants, Inc.
1160 Rockville Pk, Suite 202
Rockville, MD 20852

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
August 13-14, 1985

PARTICIPANTS

Richard W. Boubel, PhD, PE, Project Officer
DOD Environmental Leadership Project
1717 H Street, NW, Room 202
Washington, DC 20006
Phone: (202) 653-1273 AV 294-1273

Stan Lee, Contracting Officer's Representative
U.S. Army Engineer Division, Huntsville
ATTN: ED-PM
P.O. Box 1600
Huntsville, Alabama 35807
Phone: (205) 895-5803

Ralph Powell, Section Chief
Tom Byers, Engineer
Galen Seek, Paint Stripping Technician and Demonstrator
Facilities and Equipment
OO-ALC/MABEB
Hill AFB, Utah 84056
Phone: (801) 777-2042/3534

Robert A. Roberts, Project Developer and Demonstrator
(Retired from OO-ALC/MABEB on August 3, 1985)
356 East Gordon #3
Layton, Utah 84041
Phone: (801) 546-3838

Thomas E. Higgins, PhD, PE, Project Manager
CH2M HILL
1941 Roland Clarke Place
Reston, Virginia 22091
Phone: (703) 620-5200

Brian P.J. Higgins, PhD, PE, Workshop Manager
PEER Consultants, Inc.
1160 Rockville Pike, Suite 202
Rockville, Maryland 20852
Phone: (301) 340-7990

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
August 13-14, 1985

PARTICIPANTS (Continued)

BG Harold N. Campbell, Vice Commander
OO-ALC/CV
Hill AFB, Utah 84056
Phone: 801-777-5111

Gene L. Mortensen, Deputy Director of Maintenance
OO-ALC/MA
Hill AFB, Utah 84056
Phone: 801-777-3816

E. Leon Jaeger, F-4 Liason
Aircraft System Program Management
OO-ALC/MMSRA
Hill AFB, Utah 84056
Phone: AV 458-6711

LTC M.G. Moody, Staff Bioenvironmental Engineer
T. Samuel Vigil, Industrial Hygienist
Willard Ferrell, Industrial Hygienist
U.S. Air Force Hospital/SGB
Hill Air Force Base, Utah 84056-5149
Phone: (801) 777-4551/4539/1180 AV 458-4539

E. Allan Dalpias, PE, Environmental Coordinator
Civil Engineering, 2849 ABG/DEEXX
Hill Air Force Base, Utah 84056-5149
Phone: (801) 777-2065

Allen N. Budge, Corrosion Control Chemist
Dave Chase, Metallurgist and Demonstrator
Physical Sciences Laboratory
OO-ALC/MAQC
Hill Air Force Base, Utah 84056-5149
Phone: (801) 777-3644

Ken Vincent, Program Manager
PRAM Program Office
AFALC/RAX
Wright-Patterson AFB, Ohio 45433
Phone: AV 785-6201

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
August 13-14, 1985

PARTICIPANTS (Continued)

Oscar Royce, President and General Manager
Don Petersen, F-4 Blast Booth Construction Superintendent and Demonstrator
Royce Mechanical Systems, Inc.
2400 South 2050 West
Ogden, Utah 84402
Phone: (801) 731-1163

Nelson N. Hall, Chief
Restoration Division
U.S. Air Force Museum
Wright-Patterson AFB, Ohio 45433
Phone: (513) 255-6930

Mike Wayne, Industrial Engineer
WR-ALC/MABEI
Robins AFB, Georgia 31098
Phone: (912) 926-4428

Ed Williams, General Foreman of Painting
WR-ALC/MABPA
Robins AFB, Georgia 31098
Phone: (912) 926-2144 AV 468-4930 or 2144

Dillon Logue
Bioenvironmental Engineering Section
USAF Hospital
Robins AFB, Georgia 31098
Phone: AV 468-2248

2LT Mikael Spanberg
2854 CES/DEEX
Tinker AFB, Oklahoma 73135
Phone: (405) 734-3201 AV 884-3201

Charles Campbell, Chief
Aircraft Services Section
OC-ALC/MABPC
Tinker AFB, Oklahoma 73145
Phone: (405) 736-3074 AV 336-3074

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
August 13-14, 1985

PARTICIPANTS (Continued)

Bill Cain, Chemical Engineer
OC-ALC/MABEP
Tinker AFB, Oklahoma 73145
Phone: (405) 736-5986 AV 336-5986

Robert D. Dillon
Quality Control Laboratory
OC-ALC/MAQ/CC
Tinker AFB, Oklahoma 73145
Phone: (405) 736-2135

Wally Quaider, Environmental Engineer
HQ AFLC/DEPB
Wright-Patterson AFB, Ohio 45433
Phone: (513) 257-4920 AV 787-4920

Vicki Singleton, Materials Engineer
MASDC/XRS
Davis-Monthan AFB, Arizona 85707
Phone: (602) 748-5502 AV 361-5502

Michael T. Coiro, Chief
Planning Section
MASDC/MAFM
Davis-Monthan AFB, AZ 85707
Phone: (602) 748-5096 AV 316-5096

Fred Steinkamp, District Manager
CompAir Kellogg, Inc.
P.O. Box 681
Parker, CO 80134
Phone: (303) 841-2508

Daniel Skwozynski, Product Manager
CompAir Kellogg, Inc.
P.O. Box 159
Kingston, NH 03848
Phone: (603) 642-4233

PROJECT OF EXCELLENCE
HILL AIR FORCE BASE

PLASTIC MEDIA PAINT STRIPPING
AUGUST 13-14, 1985

PARTICIPATING ORGANIZATIONS

DEFENSE ENVIRONMENTAL LEADERSHIP PROJECT (DELP)

The Defense Environmental Leadership Project was initiated in January 1984 by the Director of Environmental Policy for the Secretary of Defense to develop innovative solutions to long-term environmental problems with policy and cost implications. The purpose of the Environmental Leadership Project is to improve DOD's national leadership position in environmental protection:

- o To imp: a compliance
- o To reduce wastes

DELP is responsible for the development and funding of this project on industrial processes to reduce generation of hazardous waste at DoD facilities.

Contacts: Andres Talts, MS, PE, Office Director
Richard W. Boubel, PhD, PE, Project Officer
Defense Environmental Leadership Project
1717 H Street, NW, Room 202
Washington, DC 20006
Phone (202) 653-1273 Autovon 294-1273

OGDEN AIR LOGISTICS CENTER (OO-ALC)

The Ogden Air Logistics Center is the major tenant activity at Hill AFB. It is one of five Air Logistics Centers of the Air Logistics Command. The Center has worldwide logistics management and maintenance support responsibilities for the Minuteman and Titan II missiles, Bomarc drone missile, Maverick air-to-ground missile, and Emergency Rocket Communication System. Ogden is also providing initial logistical support and system management for the Peacekeeper ICBM. The Center is logistics manager for all conventional armunitions, solid propellants, and explosive devices used throughout the Air Force.

Ogden ALC performs worldwide system program management for the F-4 Phantom and the F-16 Fighting Falcon. More than 300 fighter aircraft receive depot maintenance, modification, and repair at Hill AFB each year. The ALC Directorate of Maintenance has investigated improved methods of removing paint from aircraft and aircraft components for several years. The Center developed and tested the plastic media paint stripping process and recently put into operation the first facility which was designed and constructed to use this process on entire aircraft. For these reasons the Defense Environmental Leadership Project has selected the Plastic Media Paint Stripping Process at Hill Air Force Base as the Project of Excellence for the U.S. Air Force.

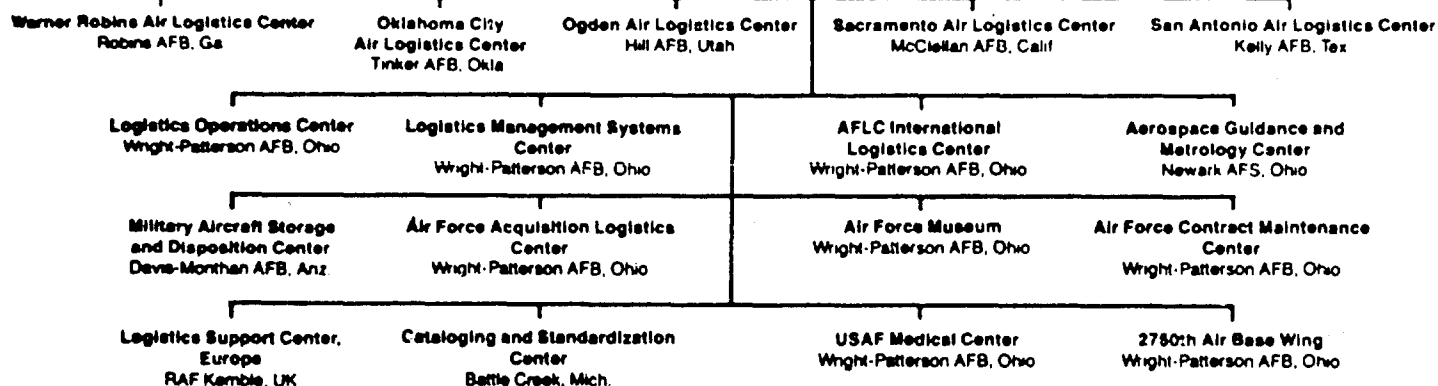
Contact: Ralph Powell, Section Chief
Tom Byers, Engineer
Facilities and Equipment
OO/ALC/MABEB
Hill Air Force Base, Utah 84056-5149
Phone (801) 777-2042/3534

PARTICIPATING ORGANIZATIONS

AIR FORCE LOGISTICS COMMAND

Headquarters, Wright-Patterson AFB, Ohio

Commander



PARTICIPATING ORGANIZATIONS (continued)

CH2M HILL

CH2M HILL is a consulting engineering firm with over 2,500 employees in more than 40 domestic and foreign offices. The firm specializes in water and waste management and in all types of civil engineering, transportation, industry, energy, and agricultural projects. CH2M HILL provides hazardous waste investigation and remediation services to Federal, State, and local governments, to the military services, and to private industry. CH2M HILL is prime contractor to DELP for this project on industrial processes to reduce generation of hazardous waste at DOD facilities.

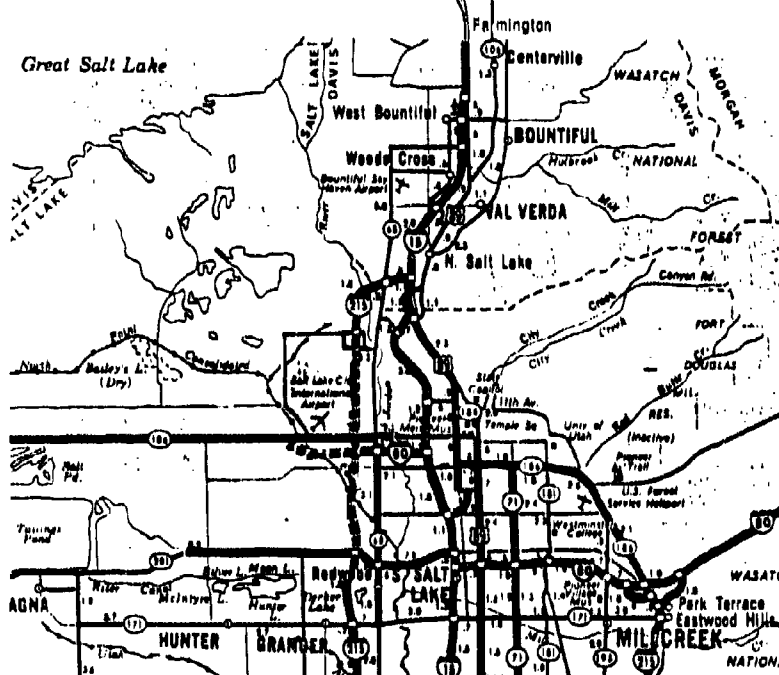
Contacts: Steve Guttenplan, MS, Manager, Industrial Wastes
Thomas E. Higgins, PhD, PE, Project Manager
CH2M HILL
1941 Roland Clarke Place
Reston, Virginia 22091
Phone (703) 620-5200

PEER CONSULTANTS, INC.

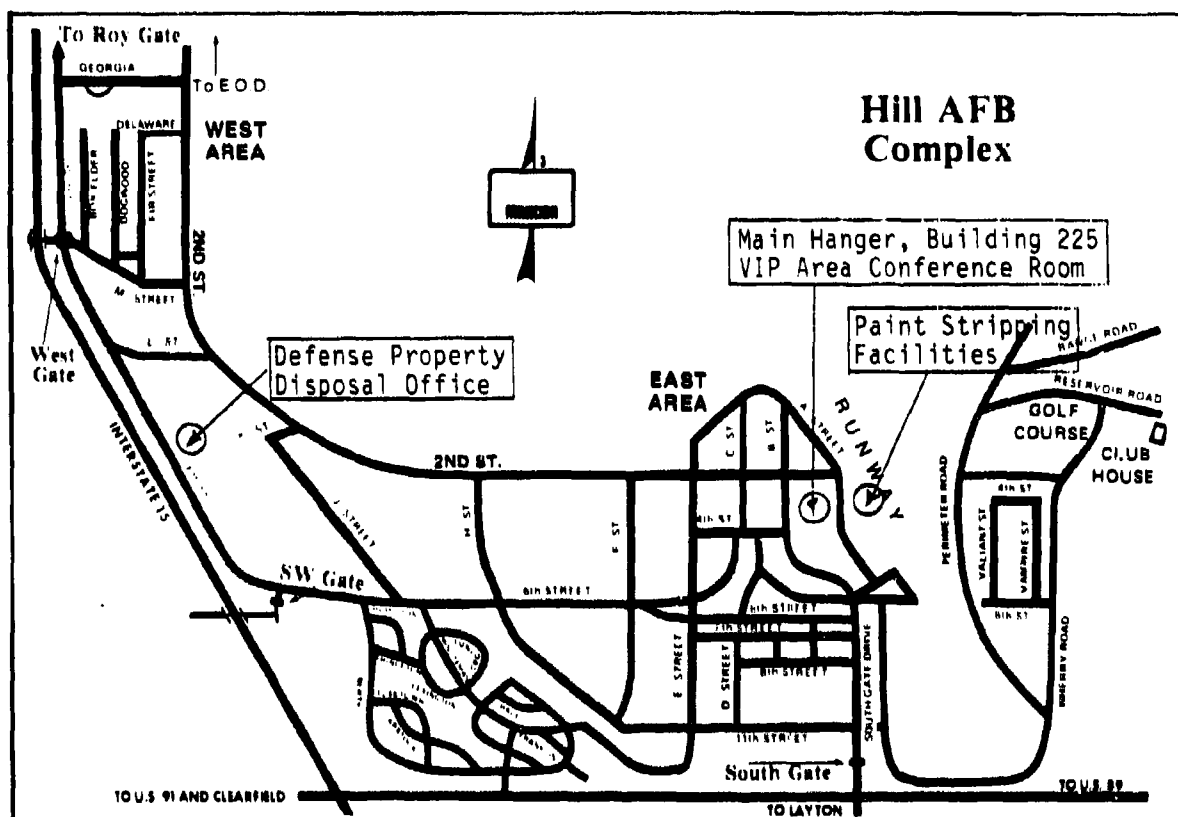
PEER Consultants, Inc., is a civil, chemical, and environmental engineering firm which provides comprehensive professional services in environmental sciences and engineering, water and wastewater systems, solid and hazardous waste management, infrastructure analysis, and information and technology transfer. PEER offices are located in Rockville, Maryland, Washington, DC, Philadelphia, Pennsylvania, and Gary, Indiana. As subcontractor to CH2M HILL, PEER Consultants is responsible for developing and conducting a two-day training program for each of three Projects of Excellence as part of this project on industrial processes to reduce generation of hazardous waste at DOD facilities.

Contacts: Lilia A. Abron-Robinson, PhD, President
Leon W. Weinberger, ScD, PE, Chief Engineer
Brian P. J. Higgins, PhD, PE, Workshop Manager
1160 Rockville Pike, Suite 202
Rockville, Maryland 20852
Phone (301) 340-7990

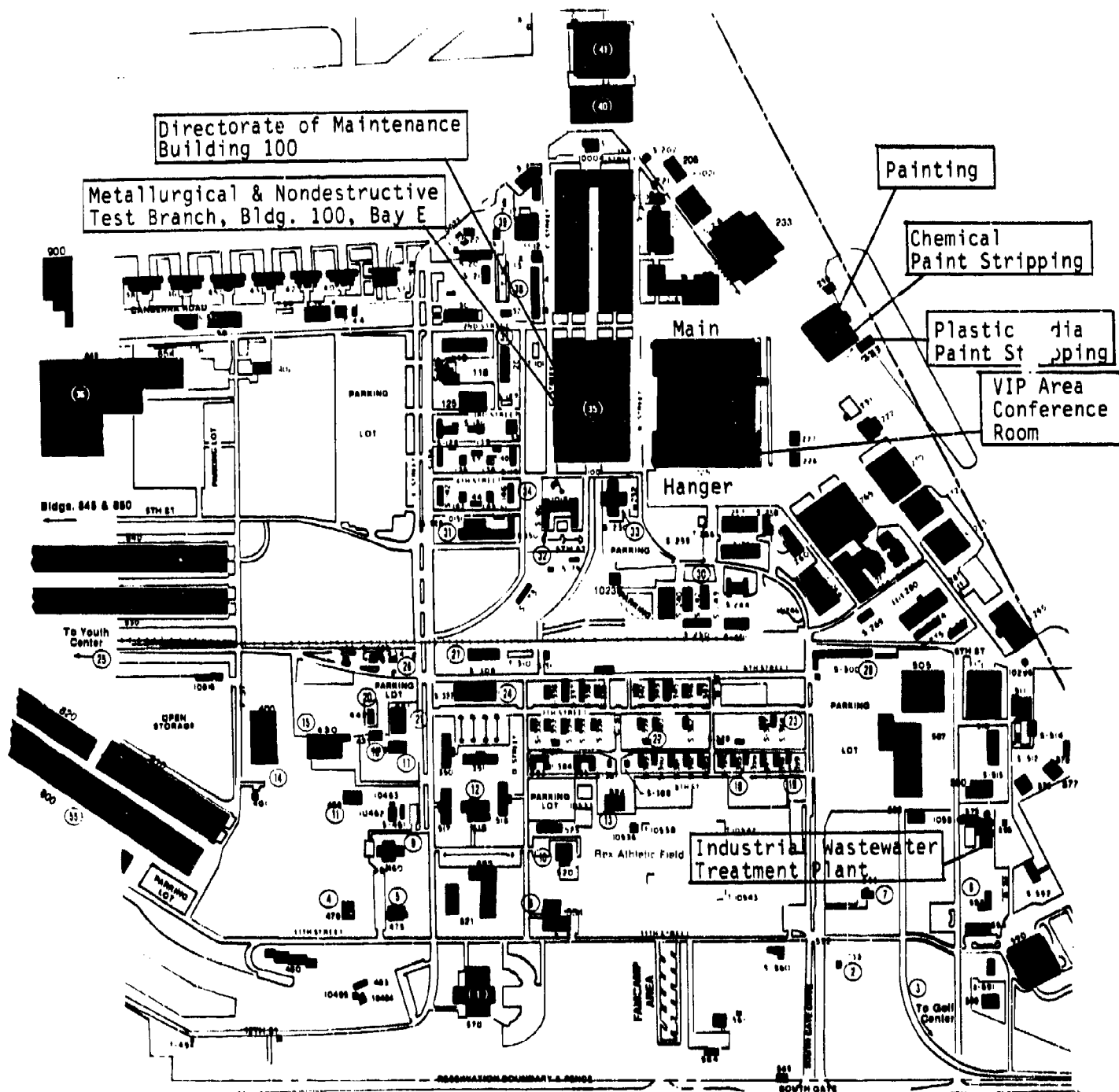
A detailed map of the Ogden, Utah area, showing major highways, cities, and landmarks. The map includes labels for cities like Slaterville, Harrisville, Ogden, South Ogden, Riverdale, Roy, Sunnyside, Clinton, Clearfield, Layton, and Kaysville. It also shows the Ogden River, Ogden Canyon, and the Ogden Air Force Base. Major highways are marked with numbers in circles, and various streets are labeled with names and numbers.



WORKSHOP LOCATION MAP 2
HILL AIR FORCE BASE



WORKSHOP LOCATION MAP 3
 CONFERENCE ROOM, TOURS & DEMONSTRATIONS
 HILL AFB EAST AREA



KEY TO NUMBERED FACILITIES IN
WORKSHOP LOCATION MAP 3
HILL AIR FORCE BASE

East Area Index

2849th ABGP HQ. (Base Commander)
Bldg. 180, Phone 72181⁽¹²⁾
388th Tactical Fighter Wing Hq. (CMDR)
Bldg. 120, Phone 73881⁽³¹⁾
Air Force Aid Society
Bldg. 180, Phone 72367⁽³²⁾
Airmen's Dining Hall
Bldg. 519, Phone 73428⁽¹²⁾
American Red Cross
Bldg. 399, Phone 73213⁽¹⁸⁾
Base Exchange
Bldg. 430, Phone 773-1207⁽²⁾
Billeting Office & Farm Camp
Registration
Bldg. 146, Phone 72601⁽³⁴⁾
BX Package Store
Bldg. 308, Phone 73237⁽²¹⁾
CBPO Customer Service
Bldg. 180, Phone 76975⁽³²⁾
Chapel
Bldg. 475, Phone 72106⁽³⁾
Child Care Center
Bldg. 470, Phone 773-4298⁽⁴⁾
Civil Engineering
Bldg. 15, Phone 73071⁽¹⁸⁾
Civilian Employment Office
Bldg. 555, Phone 73762⁽¹⁾
Commissary
Bldg. 400, Phone 72300⁽¹⁴⁾
Directorate of Distribution
Bldg. 849, Phone 74441⁽³⁶⁾
Directorate of Maintenance
Bldg. 100, Phone 73815⁽²⁵⁾
Education Office
Bldg. 368, Phone 72710⁽²¹⁾
Family Services
Bldg. 308, Phone 72301⁽²¹⁾
Family Support Center
Bldg. 308, Phone 74681⁽²⁷⁾

Federal Employees Credit Union
Bldg. 431, Phone 773-1392⁽¹⁶⁾
Bldg. 230, Phone 773-4666
Bldg. 1235, Phone 773-4304
First Security Bank
Bldg. 442, Phone 773-8000⁽²⁰⁾
Bldg. 1235, Phone 773-3872
Gentry Memorial Library
Bldg. 440, Phone 72533⁽¹⁷⁾
Golf Center
Bldg. 720, Phone 825-1817⁽¹⁾
Gymnasium
Bldg. 520, Phone 72761⁽¹⁸⁾
Hobby Shop
Bldg. 534, Phone 72649⁽⁴⁾
Hospital
Bldg. 570⁽¹⁾
Ambulance Dispatch 73233
Appointments 75224
General Information 77037
Emergency Room 75285
Household Goods Unit
Bldg. 849⁽¹⁶⁾
Inbound 75335
Outbound 75251
Housing Office
Bldg. 180, Phone 72961⁽²²⁾
Military Intro Office
Bldg. 180, Phone 73436⁽³⁷⁾
Morale, Welfare and
Recreation Supply/Loan
Bldg. 524, Phone 72225⁽¹³⁾
NCO Open Mess
Bldg. 450, Phone 73841⁽¹¹⁾
Officers Open Mess
Bldg. 150, Phone 72809⁽³¹⁾
Passenger Terminal
Bldg. 1, Phone 73142⁽⁴¹⁾
Restaurants
(Main) Bldg. 230, Phone 825-1675⁽³³⁾

Bldg. 402, Phone 825-7577
Bldg. 507, Phone 825-3212
Bldg. 1235, Phone 825-1209
Bldg. 1294, Phone 825-1209
Service Station
Bldg. 454, Phone 773-3600⁽²⁸⁾
Social Actions
Bldg. 396, Phone 73516⁽¹¹⁾
Stephenson Memorial Theater
Bldg. 441, Phone 777-3394⁽²¹⁾
Theater Schedule, Phone 777-3004
Thornton Recreation Center
Bldg. 460, Phone 73924⁽⁹⁾
Thrift Shop
Bldg. 308, Phone 825-1026⁽²¹⁾
US Post Office
Bldg. 332, Phone 72509⁽²⁴⁾
Visitors Center
Bldg. 553, Phone 72394⁽²⁾
Youth Activities Center
Bldg. 883, Phone 72419⁽²⁹⁾
Hq. 40th Air Rescue and Recovery Sq.
Bldg. 800, Phone 74741⁽³⁵⁾
Det. 4, 40th Air Rescue and Recovery Sq.
Bldg. 1, Phone 73592⁽⁴¹⁾
Det. 6, 17th Weather Squadron
Bldg. 1, Phone 73629⁽¹¹⁾
419th Tactical Fighter Wing (RES)
Bldg. 593, Phone 73119⁽¹⁾
408th Combat Logistics Support Sq.
Bldg. 243, Phone 72335⁽²⁸⁾
1881st Communications Sq.
Bldg. 11, Phone 72641⁽²¹⁾
1954th Radar Evaluation Sq.
Bldg. 500, Phone 73711⁽²¹⁾
2849th ABGP Hq. Sq. Sec.
Bldg. 390, Phone 72456⁽²²⁾
2952nd Combat Logistics Support Sq.
Bldg. 243, Phone 72121⁽³⁰⁾
6545th Test Gp and 6514th Test Sq.
Bldg. 1A, Phone 73646⁽⁴⁰⁾

1 January 1985

HOTELS/MOTELS IN OGDEN AREA

	# ROOMS	REGULAR RATE		MILITARY RATE		KITCHENNETTES
		SINGLE	DOUBLE	SINGLE	DOUBLE	
Alana Motel 116 N. Main Clearfield, Ut 825-2221	20	\$26.00	\$32.00	\$24.00	\$30.00	3
Big Z Motel 1123 W. 21 S. Ogden, Ut 394-6632	32	\$23.00	\$25.00	\$22.00	\$25.00	4
Circle R Motel 5223 S. 1900 W. Roy, Ut 773-7432	32	\$26.00	\$32.00	\$24.00 \$120.00	\$30.00 \$130.00	18
Colonial Motel 1269 Washington Blvd. Ogden, Ut 399-5851	32	\$16.00	\$20.00	\$14.00	\$18.00	4
Far West Motel 410 N. Main Kaysville, Ut 544-3475	22	\$22.00	\$30.00	\$22.00	\$28.00	11
High Country Inn 1335 W. 1200 S. Ogden, Ut 394-9474	70	\$33.00	\$39.00	\$29.00	\$34.00	0
Lazy J Motel 951 W. Riverdale Rd Riverdale, Ut 621-2990	17	\$20.00	\$24.00	10%	10%	6
Millstream Motel 1450 Washington Blvd. Ogden, Ut 394-9425	50	\$18.00 to \$24.00	\$30.00	Same	Same	14
Mountain View Motel 563 W. 24th St. Ogden, Ut 394-1414	33	\$22.00	\$28.00	\$20.00	\$26.00	29
Ogden Motel 1503 Washington Blvd. Ogden, Ut 621-0331	6	\$15.00	\$18.00	\$15.00	\$18.00	6
Valley View Motel 1500 N. Main Layton, Ut 825-1632	14	\$24.00	\$28.00	Same	Same	5

Rodeway Inn
5000 S. 1500 W.
Riverdale, Ut
627-2880

113 \$44.00 \$52.00 \$30.00 \$40.00
Tue - Fri All You Can Eat Breakfast With Room

Radisson
2510 Washington Blvd.
Ogden, Ut
627-1900

104 \$55.00 \$65.00 \$39.00 \$45.00
\$79.00 \$89.00 \$49.00 \$47.00

Villa Capri Motel
1100 S. Hwy 89
Kaysville, Ut
544-3439

25 \$26.00 \$30.00 Same Same 25

Wayfarer Inn
3750 Washington Blvd.
Ogden, Ut
393-1885

8 \$15.00 \$23.00 Same Same 0

Flying J Motel
1206 W. 2100 S.
Ogden, Ut
393-8644

80 \$32.00 \$37.00 \$27.00 \$33.00 2

Hilton Inn
247 24th Street
Ogden, Ut
627-1190

288 \$42.00 \$59.00
to to
\$77.00 \$94.00 \$32.00 \$40.00 0

Holiday Inn
3306 Washington Blvd.
Ogden, Ut
399-5671 -

109 \$39.00 \$44.00 \$27.00 \$35.00 0

Ogden Imperial
1956 Washington Blvd.
Ogden, Ut
393-8667

35 \$25.00 \$32.00 \$23.00 \$30.00 3

Motel 6
1455 Washington Blvd.
Ogden, Utah
399-9261

72 \$18.00 \$22.00 Same Same 0

Travelodge
2110 Washington Blvd.
Ogden, Ut
394-4563

77 \$29.00 \$34.00 \$24.00 \$29.00 0

Red Baron Motel
1825 Washington Blvd.
Ogden, Ut
621-8350

92 \$25.00 \$32.00 \$21.00 \$24.00 3

Putnam's
234 24th Street
Ogden, Ut
627-1332

14 \$25.00 \$30.00 2



January 1985

MORALE, WELFARE AND RECREATION DIVISION
William "Scotty" Wilson, Chief/73239

RECREATION SERVICES BRANCH
Michael G. Bryson, Chief/72651

FINANCIAL MANAGEMENT BRANCH
Michael L. Goodsell, Chief/77694

SECTION	*DAILY HOURS OF OPERATION		PHONE	BLDG	MGR/SUPV
Aquatic Section - Pool #1	Mon-Fri	0600-2100	777-4617	520	Connie Wages
	Sat/Sun/Hol	1100-1700			
Pool #2	CLOSED				
Pool #3	CLOSED				
Arts & Crafts Center	Mon	CLOSED	777-2649	534	Lynda Sheltnire
	Tue-Thur	1200-2000	777-9625		
	Fri	1000-1800			
Auto Hobby	Sat	0830-1800	777-3476		
Crafts	Sat	1000-1800			
Auto Hobby	Sun	1000-1800			
Wood Shop	Sun	1200-1700			
Bowling Center	Mon-Thur	0830-2300	777-6565	525	Jim Kuralt
	Fri	0830-0100			
	Sat	0800-0100			
	Sun	1100-2200			
Snack Bar	Mon-Fri	0900-2200			
	Sat	1030-2200			
	Sun	1100-2000			
** Carter Creek Reservations made at Ticket & Tour Office, 777-2892	Opens approximately 29 Jun, Closes 1 Nov.		777-2333	564	Wendell Collier
Child Care Center	Mon-Thur	0630-1800	773-4298	470	Vera Kelson
	Fri	0630-0100	777-6321		
	Sat	1730-0100			
	Sun/Holidays	CLOSED			
Civilian Recreation	Provides year-round programs		777-3661	564	David Ovard
Civilian Sports Loan	Mon-Wed	0800-1630	777-2526	524	Val Youngberg
	Thur-Fri	0800-1800			
	Sat-Sun	0800-1300			
Class VI Store	Mon-Sat	1100-1900	777-2169	308	Everett Roberts
FAMCAMP Registrations made in person at Billeting	Open seven days a week 1 Apr through 31 Oct.		777-2333	564	Wendell Collier
Golf Course (Weather permitting)	Mon	1200-Dusk	777-3272	720	Wayne Volk
	Tue-Sun	0800-Dusk			
Gymnasium	Mon-Fri	0600-2300	777-2761	520	Jim Martin
	Sat	0900-1800	777-2762		
	Sun	1100-1800			
Aerobics Exercise	Mon-Wed-Fri	0600-0700			
		0900-1000			
***Hillhaus Lodge For reservations, call the Ticket and Tour Office, 777-2892.	Ski season - approx 22 Nov - 15 Apr		777-2333	564	Wendell Collier
	Thur	1100-2000	(Lodge opens)		
	Fri/Sat/Sun	0700-2000			
	Mon	0700-1630			
	Tue-Wed	CLOSED			
	Breakfast	0700-0900			
	Lunch	1200-1400			
	Dinner	1600-1900			
Hill Riding Club	Available for members 24- hours per day xix		777-4832		Capt Roy Clapper

Hill Rod & Gun Club		Tue - Trap Thur - Skeet Sun - Skeet	1630-1900 1600-1800 1200-1700	777-5984		Robert Walker
Library		Mon-Thur Fri-Sun	1000-2200 1000-1730	777-2533 777-3833	440	William Nottoli TSgt
MWR Supply/Sports Loan		Mon-Wed Thur-Fri Sat-Sun	0800-1630 0800-1800 0800-1300	777-2225	524	Val Youngberg
MWR Information Line		24-HOURS DAILY		777-2004	180	Nadine Parkinson
NCO Club	Dining Room	Mon-Thur Fri Sat Sun/Holidays	0630-2130 0630-2200 0730-2200 0830-2130	777-3841	450	Dean Peterson
	Cocktail Lounge	Mon-Thur Fri Sat Sun	1530-2340 1530-0040 1900-0040 Specials Only			
	Casual Bar	Mon-Thur Fri Sat Sun/Holidays	1530-2340 1530-0040 1100-0040 1100-2340			
Officers' Club	Heritage Room	Mon-Fri	0600-0830 1100-1330	777-2809	150	William Crum
		Mon-Thur Fri-Sat Sun	1800-2130 1800-2200 1100-1400 1800-2100			
	Cashier	Mon-Thur Fri Sat Sun	0830-2100 0830-2300 1600-2300 1100-1400 1600-2100			
	Covered Wagon Bar	Mon-Sat Sun	1600-Closing CLOSED			
	Heritage Room Bar	Accommodates Dining Room				
	Golf Course Clubhouse	Parties by reservation				
Restaurants		Mon-Fri Mon-Fri Mon-Fri Mon-Fri 24-hours daily Mon-Fri	0630-1430 0700-1400 0645-1700 0700-1300 0600-1400 1750-2015	825-1209 825-3213 777-6219 777-7515 777-2043 777-9924	1235 507 849 1294 230 225 225	Calston Scott
Thornton Recreation Center		Mon-Thur Fri Sat Sun/Holidays	0900-2300 0900-0100 1100-0100 1100-2300	777-3924	460	Cordell Ferry
	Retreat Snack Bar	Mon-Thur Fri Sat Sun/Holidays	0900-2300 0900-0100 1100-0100 1100-2300	773-4951	460	Mary Crosson
Ticket and Tour Office		Mon-Fri Sat-Sun Holidays	0900-2000 1100-1700 CLOSED	777-2892	460	Dee Mays
Youth Activities		Mon-Thur Fri Sat Sun	1500-2100 1500-2300 1300-2300 1300-1800	777-2419	863	Jim Dobbs
Log Cabin		Sun-Sat	0700-0100	777-3924	804	Cordell Ferry
Parties, receptions, conferences, etc - for reservations, call Ticket & Tour Office 72892.						

*Because hours are subject to change, please call the facility for verification.

**Carter Creek is located 105 miles from Hill AFB on the north slopes of the Uintah Mountains.

(For military and family members and retired military and family members only.)

***Hillhaus is located .8 of a mile from Snowbasin Ski Resort, approximately 29 miles from Hill AFB.

1.0 INTRODUCTION

- 1.1 Welcome
- 1.2 Background
 - 1.2.1 Environmental Laws and Regulations
 - 1.2.2 The Resource Conservation and Recovery Act
 - 1.2.3 Federal Compliance With Pollution Control Standards
 - 1.2.4 DoD Policies Regarding Hazardous Waste
- 1.3 The Defense Environmental Leadership Project
- 1.4 Project Goals and Procedures
 - 1.4.1 Phase 1: 40 Case Studies
 - Features of Successful Process Modifications
 - Phase 1 Evaluation Results
 - 1.4.2 Phase 2: 18 Case Studies
 - 1.4.3 Phase 3: 3 Projects of Excellence
- 1.5 General Recommendations for Successful Process Modifications

Presentation by Richard Boubel, Project Officer, DELP
Defense Environmental Leadership Project (DELP)
Productivity Enhancing Capital Investments (PECI) Program

1.0 INTRODUCTION

1.1 Welcome

Welcome to Hill Air Force Base for a Project of Excellence workshop on Plastic Media Paint Stripping sponsored by the Department of Defense Environmental Leadership Project. The purpose of this program is to thoroughly inform selected Air Force decision-makers about a significant paint stripping process modification which has tremendous potential for:

- o Increasing productivity
- o Increasing quality control
- o Reducing health risks to workers
- o Reducing the generation of hazardous wastes, and
- o Saving money.

The overall purpose of this training program is to assure adoption of practical, cost and energy efficient, industrial process modifications to reduce hazardous waste generation at DoD facilities.

This two-day workshop will focus on the following aspects of this Project of Excellence:

- o Background and Purpose
- o Project Description
- o Alternative Technologies
- o Project Requirements
- o Production Benefits
- o Environmental Benefits
- o Demonstrations and Tours

This package of written materials is given to each participant for reading, note-taking, and future reference. The front part of these materials contains the Agenda, List of Participants, Description of Participating

Training workshop planned

The Environmental Protection Agency office of the Department of Defense has assigned CH2M Hill and PEER consultants to establish a Defense Environmental Leadership Project for the study of long-term environmental issues.

For the past year, the DELP has been conducting a study of military industrial process modifications made to reduce the generation of hazardous waste. As the culmination of the study, a Project of Excellence was designated for each of the armed services and for the Air Force, the outstanding project selected is the plastic media aircraft paint removal process here.

DELP, through the consultants, is preparing a training and demonstration workshop for this Project of Excellence to be held here Tuesday and Wednesday.

Plastic media paint stripping is cur-

rently the most promising replacement for conventional solvent stripping of aircraft. Here, the process change has proven itself to significantly reduce production costs and manpower requirements, improve worker safety, improve product quality, and substantially reduce the generation of wastes.

Robert A. Roberts, project developer from the Directorate of Maintenance here, will demonstrate the new process. Mr. Roberts and other members of the directorate have investigated improved methods of removing paint from aircraft and aircraft components for several years. The center developed and tested the plastic media paint stripping process and recently put into operation the first facility which was designed and constructed to use the process on entire aircraft.

Organizations, and Location Maps for the workshop.

Each section corresponds to one or more of the scheduled workshop sessions, demonstrations, and tours. Various audio-visual aids, such as slides, exhibits, and a videotape, will also be used. The program is structured to proceed from an overview of the project to a detailed description of project requirements and benefits and a hands-on demonstration. Sessions consist of sit-down discussions in the mornings and on-site demonstrations and tours in the afternoon.

The program is intended to be informal and flexible so that maximum interest and information can be generated and transferred. All participants are encouraged to ask questions and to contribute relevant observations from their own experience for the benefit of the whole group.

Further information on any aspect of the program can be obtained from the appropriate participants and participating organizations. Names, addresses, and telephone number are listed in the front part of the training materials. All participants are encouraged to send information concerning their past, present, and future experience with measures to reduce hazardous waste generation, both successful and unsuccessful, to the Defense Environmental Leadership Project, for everyone's mutual benefit.

1.2 Background

1.2.1 Environmental Laws and Regulations

During the past 20 years the United states has experienced increased awareness of the impacts of people and technology on the natural and social environment.

In the National Environmental Policy Act of 1969, Congress stated that:

"It is the continuing policy of the Federal Government . . . to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans."

Since 1969, Congress has passed and amended numerous laws to protect human health and the environment. Major environmental legislation includes:

1. The Clean Water Act (CWA),
2. The Clean Air Act (CAA),
3. The Toxic Substances Control Act (TSCA),
4. The Resource Conservation and Recovery Act (RCRA), and
5. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or "Superfund").

The U.S. Environmental Protection Agency (EPA) is primarily responsible for developing regulations to implement and enforce these laws. EPA regulations appear under Title 40 of the Code of Federal Regulations. Many proposals for new and revised regulations appear in the Federal Register as laws change and as understanding of environmental and regulatory processes increases. State and local governments frequently adopt their own laws and regulations for environmental protection.

Many Federal, State, and local regulations require that those who generate wastes or release pollutants to the environment obtain permits to do so. Individuals, businesses, and public agencies are responsible for complying with environmental laws, regulations, and permit conditions which pertain to them. They should comply in order to protect the environment and the health and welfare of society.

1.2.2 The Resource Conservation and Recovery Act

Section 1003 of the Resource Conservation and Recovery Act (RCRA) of 1976 states that: "The objectives of this Act are to promote the protection of health and the environment and to conserve valuable material and energy resources." Subtitle C of RCRA directed the EPA to develop and implement a national program to manage hazardous waste. In response to RCRA, EPA has established:

1. Criteria for the identification and listing of hazardous waste;
2. Regulations for generators and transporters of hazardous waste; and
3. Regulations and permit requirements for facilities which treat, store, or dispose of hazardous waste.

The regulations require extensive labeling, recordkeeping, and reporting practices to control hazardous waste "from cradle to grave."

Once hazardous waste is generated, it is usually difficult and costly to manage. Management methods include recycling, treatment, and disposal. Recycling and treatment often result in some residual hazardous waste which still requires disposal. Disposal methods include landfilling, underground placement, and incineration. Much hazardous waste is currently landfilled, but secure landfills which meet EPA requirements for hazardous waste disposal are few in number, difficult to site, and costly to operate. In addition, there are many concerns about the long-term impacts and risks associated with each method of hazardous waste disposal.

The Hazardous and Solid Waste Amendments of 1984 make RCRA more widely applicable and more stringent in many respects (See Appendix 1.1 of these training materials). For instance, the new provisions include:

1. Bans on placement of bulk liquid hazardous waste in landfills, and on certain other disposal practices;
2. Requirements for double-liners and leachate collection systems at surface impoundments and landfills;

3. Additional requirements for monitoring groundwater and taking corrective actions where needed;
4. Restrictions on a facility's permit life;
5. Authority to add conditions to a permit beyond those provided for in the regulations; and
6. Requirements for generators and owners or operators of treatment, storage and disposal facilities to certify that they have instituted a waste minimization program.

As the management of hazardous waste becomes even more difficult and costly, measures to reduce or entirely eliminate the generation of hazardous waste become more attractive.

1.2.3 Federal Compliance With Pollution Control Standards

Executive Order 12088 (October 13, 1978) states that:

"The head of each Executive agency is responsible for ensuring that all necessary actions are taken for the prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under the control of the agency. The head of each Executive agency is responsible for compliance with applicable pollution control standards, including those established pursuant to, but not limited to, the following" (See Appendix 1.2):

1. Toxic Substances Control Act,
2. Federal Water Pollution Control Act,
3. Clean Air Act,
4. Noise Control Act, and
5. Solid Waste Disposal Act, as amended (this includes the Resource Conservation and Recovery Act of 1976 and the Hazardous and Solid Waste Amendments of 1984).

EO 12088 requires that each Executive agency cooperate with the EPA Administrator and with State, interstate, and local agencies in the prevention, control, and abatement of environmental pollution. It states that:

"Whenever the Administrator or the appropriate State, interstate, or local agency notifies an Executive agency that it is in violation of an applicable pollution control standard, the

Executive agency shall promptly consult with the notifying agency and provide for its approval a plan to achieve and maintain compliance with the applicable pollution control standard. This plan shall include an implementation schedule for coming into compliance as soon as practicable."

"Exemptions from applicable pollution control standards may only be granted . . . if the President makes the required appropriate statutory determination: that such an exemption is necessary (a) in the interest of national security, or (b) in the paramount interest of the United States."

EO 12088 applies to all facilities and activities under the control of the Department of Defense. Exemptions are not expected to be granted except during mobilization or time of war.

1.2.4 DoD Policies Regarding Hazardous Waste

In May of 1980, the Office of the Assistant Secretary of Defense issued Defense Environmental Quality Program Policy Memorandum DEQPPM 80-5 to provide DoD policy guidance on the disposal of hazardous materials. The Defense Logistics Agency (DLA) was designated the responsible agency within DoD for worldwide disposal of all hazardous materials, except for those categories of materials specifically designated for DoD component disposal. DEQPPM 80-5 (Appendix 1.3) and Chapter XXI of DoD 4160.21-M (Appendix 1.5) assign DoD components and installations with the responsibility to "Where feasible, minimize quantities of hazardous waste through resource recovery, recycling, source separation, and acquisition policies."

In August of 1980, DoD policy memorandum DEQPPM 80-8 affirmed that DoD policy is:

"To limit the generation of hazardous waste through alternative procurement and operational procedures that are attractive environmentally yet are fiscally competitive, (and) . . . to reutilize, reclaim, or recycle resources where practical and thus conserve on total raw material usage." (Appendix 1.4)

In carrying out the intent of these policies, numerous studies have been performed at DoD facilities which recommended modifications to industrial processes to reduce the generation of hazardous wastes at the source, rather than treating the wastes at end-of-pipe treatment facilities. Many of these studies recommended process modifications with excellent cost/benefit ratios. Several of these have been successfully implemented. However, others have either not been implemented or were improperly applied.

1.3 The Defense Environmental Leadership Project

Military installations and programs have often had significant impacts on the environment because of their location, size, and mission. In order to encourage leadership in environmental protection the Department of Defense has undertaken a major environmental program called the Defense Environmental Leadership Project (DELP). A Project Office has been established under the Environmental Policy Directorate of the Office of the Secretary of Defense to study long-term environmental issues that have important cost and policy implications. Project staff are examining both technical and policy issues in order to significantly upgrade DoD's environmental perspective and performance.

In addition to its many other activities, DELP has developed and funded a three-phased project, of which this workshop is a part of Phase 3, to encourage the development and implementation of industrial process modifications which reduce hazardous waste generation at U.S. Army, Navy, and Air Force facilities. The goal of another DELP project is to develop an incentive program so that commanders who adopt environmental protection measures which save government money can retain the money for other activities. DELP is also developing methods to more realistically determine the total costs of DoD hazardous waste treatment, storage and disposal activities.

1.4 Project Goals and Procedures

DELP has been conducting this comprehensive three-phased project since mid-1984. A major goal of the project is to develop an in-depth analysis of both successful and unsuccessful attempts to reduce hazardous waste. Project procedures include:

1. Analysis of sites which have been previously studied for reduction of hazardous wastes by either process modifications or change to alternative processes. Sites include those where recommended modifications have been successfully implemented, as well as those which showed potential benefits, but where no action or inadequate action was taken.

2. Identification of management techniques that cause needed changes to be implemented.

3. Integration of successful techniques into operational procedures that will assure future adoption of practical, cost and energy efficient, industrial process modifications to reduce hazardous waste generation.

The analysis concentrated on a few processes that generate the greatest proportion of DoD hazardous waste. The Defense Department operates industrial facilities to clean, repair, and recondition a wide variety of military equipment, including airplanes, helicopters, ships, wheeled and tracked vehicles, and other weapons systems and equipment. Metal finishing operations are performed on military equipment and their components at more than 100 DoD industrial facilities. Metal finishing operations generate most of DoD's hazardous waste. These operations include:

1. Paint stripping,
2. Solvent cleaning,
3. Metal plating, and
4. Painting

Solvent wastes and toxic metal wastes from these processes are the principal hazardous wastes at DoD facilities.

This analysis of process modifications is being conducted under the assumption that the technology to reduce hazardous waste generation is already in existence. This particular DELP project was not intended to fund technology research, development, or implementation. However, project deliverables, including reports, training materials, and three workshops, are structured to promote technology transfer and to encourage wider use of successful process modifications.

1.4.1 Phase 1: 40 Case Studies

During Phase 1 of the project, 40 cases of industrial process modifications at Army, Navy, and Air Force installations were evaluated, and 18 cases were recommended for further study during Phase 2. As shown in Table 1.1, process modifications involving paint stripping, painting, metal plating, and solvents represented most of the 40 cases. Additional cases involved explosives manufacturing, jet engine test cells, fire fighting equipment, fuel tank cleaning, and purchase and use specifications. Cases were evaluated on the basis of costs, energy consumption, technical practicality, management, incentives, and program monitoring and auditing. The primary factor in evaluating the cases was not whether they had been successful, but whether they were useful as examples of how such processes could be modified.

Many times, the success or lack of success of the modification can be attributed not to the technology, but rather to the management, training, and incentive programs that were developed and put into place along with the technology. The Phase 1 report (CH2M HILL, February 1985) identifies managerial techniques that stimulate acceptance and successful implementation of the selected process modifications.

Table 1.1 Type and Number of Process Modifications
Evaluated in Phase 1.

<u>Type of Operation</u>	<u>Number of Modifications Evaluated</u>			
	<u>Army</u>	<u>Navy</u>	<u>Air Force</u>	<u>Total</u>
Paint Stripping	1	2	1	4
Painting	-	3	2	5
Metal Plating	3	9	1	13
Recycle of Solvents and Other Organic Fluids	1	6	3	10
Explosives Manufacturing	4	-	-	4
Jet Engine Test Cell	-	-	1	1
Fire Fighting Training	-	1	-	1
Fuel Tank Cleaning	-	1	-	1
Purchase & Use Specifications	<u>-</u>	<u>1</u>	<u>-</u>	<u>1</u>
Total	9	23	8	40

Features of Successful Process Modifications

Industrial modifications were generally found to be successful; however, some modifications failed and others could not be adequately evaluated.

While there are specific circumstances and reasons behind the success or lack of success of each modification attempted, two characteristics have been integral parts of each of the successful process modifications and at least one of these elements has been missing from the modifications that have been less than successful. Very simply stated, in process modifications that were successfully implemented, the end user was sufficiently motivated to make the change and the technologies were "elegant in their simplicity." Factors which have motivated personnel included improved production rate or quality, reduced overall costs, decreased manpower requirements, and decreased quantity of hazardous wastes to be disposed of. Technologies that were "elegant in their simplicity" were easy to operate and maintain, reliable, and cost effective. Successfully implemented process modifications combined effective technology and motivated personnel to significantly reduce hazardous waste production by substantially changing the process, substituting raw materials, or recovering and reusing waste by-products.

In general, a number of common features distinguished successful process modifications from those that were not. These features are outlined below:

1. Production people were enthusiastically and actively involved in implementing successful process modifications. This usually required that some incentive be offered by the modification, such as reduced manpower requirements or simplification of the process. The change could not harm product quality, and preferably was an improvement over existing processes.

2. A "champion," who strongly believed in the modification, ramrodded the project, and overcame developmental problems and the inertia that protects existing processes (especially those that function, although they may produce undesirable wastes).

3. Care was taken to tailor the modification to the individual facility. During design and installation, many operations personnel were included to obtain their input and to inspire them to adopt the process change.

4. Support was provided at a sufficiently high level in the chain of command to influence production and environmental policy decisions. Frequently, waste disposal and environmental protection had been viewed as service functions, subservient to the mission of the facility, which was usually production-oriented. Successful modifications usually required the reallocation of resources from production functions to environmental protection. Allocation of manpower slots for environmental protection was particularly difficult to obtain.

5. The technologies tended to require "evolutionary rather than revolutionary" changes. That is, off-the-shelf equipment was adapted to a new application, and special or complex equipment was avoided.

6. Successful modifications were straightforward and simple to operate, thus requiring minimal training for personnel unfamiliar with the technology involved.

7. Process reliability had to be high so as not to adversely affect production. Maintenance requirements were minimal.

8. At facilities where modifications were successful, true costs of hazardous waste disposal were appreciated by management, and were considered in the decision to implement the modifications. At DoD facilities, the Defense Property Disposal Office (DPDO) takes hazardous waste, which must be disposed of off the installation, without charge. This has resulted in a disincentive to production people to reduce their generation of hazardous wastes, since costs of waste disposal are not charged to production activities. At some installations, industrial treatment facilities have been sized to handle the existing waste flow. This has resulted in a disincentive to reduce waste production.

Phase 1 Evaluation Results

Table 1.2 (Table 13.1 from the CH2M HILL Phase 1 Report) shows the assessment of each case, and indicates the 18 cases recommended for further study in Phase 2. Cases were favored in which modifications were seriously attempted, had a widespread application, and had the potential of effecting a significant reduction in hazardous waste generation. Cases recommended for further study in Phase 2 of the project are designated with an asterisk (*).

In all but two cases, the cases earning the highest score under an assessment model were recommended for further study. The two cases earning high scores, but not recommended for further study (Case No. 24, Solvent Recovery at Kelly AFB, and Case No. 22, Dry Media Paint Stripping, Alameda NARF), both failed to offer sufficient information to warrant further evaluation. -

Some process modifications were not implemented for immediately obvious and overwhelming reasons, such as lack of money or manpower. For these cases, little additional useful information would be obtainable for further evaluation. Cases were favored in which the modification was seriously attempted, resulting in the production of reports or other information suitable for further analysis.

Some of the cases involved wastes that would not be classified as hazardous under EPA regulations. Since the purpose of this project is to evaluate process modifications to reduce generation of hazardous wastes, these cases were considered to be less useful than those that dealt with hazardous wastes.

An assessment model was prepared to help evaluate cases for consideration for Phase 2 of the project. This model contained the following five criteria:

1. Concrete Example: Was there a modification proposed, and is sufficient information available (i.e. existing operation, reports, conversations with personnel) to perform a detailed study of the modification?

EVALUATION RESULTS (1)

CASE NO.	FACILITY, MODIFICATION	CRITERIA (1)					STUDY VALUE	(2)	NOTES (3)	(4)	REPORT SECTION
		A	B	C	D	E					
1	Hill AFB, Dry Paint Stripping	1.0	1.0	1.0	1.0	1.0	10.0	S		*	3.4.1
4	Robins AFB, Solvent Recycle	1.0	1.0	1.0	1.0	1.0	10.0	S		*	6.4.1
10	Pensacola NARF, Spray Rinse	1.0	1.0	1.0	1.0	1.0	10.0	S		*	5.4.4
26	Pensacola NARF, Dry Paint Strip	1.0	1.0	1.0	1.0	1.0	10.0	S		*	3.4.3
5	Tyndall AFB, Solvent Recycle	0.7	1.0	1.0	1.0	1.0	9.4	U	b	*	6.4.2
18	Anniston Army Depot, Plating	1.0	1.0	0.7	1.0	1.0	9.4	S		*	5.4.7
8	Norfolk NSY, Solvent Recycle	1.0	0.5	1.0	1.0	1.0	9.0	S		*	6.4.4
24	Kelly AFB, Solvent Recycle	0.5	1.0	1.0	1.0	1.0	9.0	N	g	*	6.4.6
7	Norfolk NARF, Heptane Recycle	1.0	0.7	0.7	1.0	1.0	8.8	U	a, c	*	6.4.3
22	Alameda NARF, Dry Paint Strip	0.3	1.0	1.0	1.0	1.0	8.6	N	k	*	3.4.2
23	Wattsville Army Arsenal, Modern Plating	0.5	1.0	1.0	1.0	0.7	8.4	S		*	5.4.10
6	Lockheed(USAF), CD Plating	1.0	0.5	0.7	1.0	1.0	8.4	S		*	5.4.1
16	Tobyhanna AAP, Waste Treatment	1.0	0.5	0.7	1.0	1.0	8.4	S		*	5.4.6
27	Pensacola NARF, Water Primer	1.0	0.5	0.7	1.0	1.0	8.4	S		*	4.4.3
39	Anniston Army Depot, Solvent Recycle	1.0	0.5	0.7	1.0	1.0	8.4	S		*	6.4.9
33	NARF's IVD of Aluminum	1.0	0.7	0.7	1.0	0.7	8.2	S		*	5.4.13
2	Hughes (USAF), Powder Coating	1.0	0.5	0.5	1.0	1.0	8.0	S		*	4.4.1
3	Lockheed (USAF), Painting	0.7	0.3	1.0	1.0	1.0	8.0	U	a	*	4.4.2
40	Norfolk NSY and NARF, Shelf Life	0.5	1.0	1.0	0.5	1.0	8.0	U	b	*	11.4.1
12	Charleston NSY, LICON Unit	1.0	0.5	0.7	1.0	0.7	7.8	U	c, d, e, f	*	5.4.3
9	Pensacola NARF, LICON Unit	1.0	0.5	0.7	1.0	0.7	7.8	U	c, d, e, f	*	5.4.2
14	Radford AAP, Pink Water	1.0	0.7	0.5	1.0	0.3	7.0	S		*	7.4.3
29	Pensacola NARF, Solvent Recycle	0.3	0.5	0.7	1.0	1.0	7.0	U	m	*	6.4.8
34	Navy, Electrostatic Paint	0.5	0.5	0.5	1.0	0.7	6.4	U	e	*	4.4.3
30	Pensacola NARF, Machine Coolant	1.0	0.3	0.3	1.0	0.5	6.2	U	e, l	*	6.4.10
13	Radford AAP, NO _x Control	1.0	1.0	0.5	0.0	0.3	5.6	U	d, h	*	7.4.1
15	Milan AAP, Pink Water	0.7	0.5	0.3	1.0	0.3	5.6	S		*	7.4.4
20	Alameda NARF, Rinse Controls	0.3	0.5	0.3	1.0	0.7	5.6	U	e, j	*	5.4.9
25	Holston AAP, NO _x Treatment	1.0	1.0	0.5	0.0	0.3	5.6	U	d, h	*	7.4.2
38	Navy, Fuel Tank Cleaning	0.5	0.5	0.5	0.3	1.0	5.6	U	e	*	10.4.1
28	Pensacola NARF, Epoxy Paint	0.3	0.5	0.3	1.0	0.5	5.2	U	f, d	*	4.4.3
31	Mare Island NSY, Plating	0.3	0.5	0.3	1.0	0.5	5.2	S		*	5.4.11
19	Alameda NARF, CN Rinse Changes	1.0	0.0	0.0	1.0	0.3	4.6	S		*	5.4.8
35	NAS's Fire Fighting	1.0	0.3	0.3	0.0	0.7	4.6	S		*	9.4.1
36	Charleston NSY, Refrigerant	1.0	0.5	0.3	0.0	0.3	4.2	S		*	6.4.7
17	Anniston Army Depot, Wet Paint Strip	0.0	0.0	0.0	1.0	1.0	4.0	N	i	*	3.4.4
21	NARF Dry Jet Engine Test	1.0	0.0	0.3	0.0	0.5	3.6	S		*	8.4.1
32	NARF's Water Over MeCl ₂	0.0	0.0	0.0	1.0	0.5	3.0	N	i	*	5.4.12
37	Norfolk NSY, Refrigerant Recycle	0.3	0.5	0.3	0.0	0.3	2.8	U	c	*	6.4.8
11	Pensacola NARF, Cond. Recovery	0.5	0.0	0.0	0.0	0.5	2.0	N	g	*	5.4.5

FOOTNOTES TO TABLE 1.1

(1) Key to evaluation of modifications

Each modification was assigned a score for each of the five criteria applied in evaluating a given modification. The criteria applied, and the five scores possible for each criteria, are shown below. The total score was then doubled to come up with the study value assigned.

Criteria	Weighting Value				
	1.0	0.7	0.5	0.3	0.0
A Concrete Example	Yes		Questionable		No
B Waste Reduction	Major		Moderate		Minor
C Waste Generation	Major		Moderate		Minor
D EPA Hazardous Waste	Yes		Sometimes		No
E Potential Use	Widespread		Limited		Unique

(2) S Process modification was judged successful in that it accomplished its goal, was cost-effective and sustainable.

U Process modification was judged not successful for reasons delineated under "Notes"

N Process modification was not yet implemented, or there was not sufficient information available to evaluate the modification.

(3) NOTES (Reasons for Lack of Success)

- Negative impact on product quality.
- Lack of authority by those attempting to implement the modification.
- Lack of manpower.
- Poor reliability or maintainability.
- Inappropriate technology application.
- Required skilled operators.
- Process evaluation in progress, insufficient information.
- Process consumables no longer commercially available.
- No process modification was known to have been proposed.
- Lack of space to locate the required equipment.
- Not implemented, pending demonstration results at other facilities.
- Physical properties of the material to be recycled kept changing.
- Operation was discontinued due to lack of technical support and incentives to reduce hazardous wastes.

(4) * Recommended for additional study during Phase 2 of the project based on study value and availability of information to evaluate.

TABLE 1.2 Phase 1 Evaluation of 40 Case Studies

Source: CH2M HILL, April 1985.

TABLE 13.1

EVALUATION OF CASE STUDIES



2. Waste Reduction: To what extent would the proposed modification, if successful, affect a significant reduction in waste generation at the facility?

3. Waste Generation: At the average facility using the industrial process, how much waste is produced that would be affected by the proposed modification?

4. EPA Hazardous Waste: Would the affected waste be classified as a hazardous waste under EPA regulations? (For a detailed description of EPA hazardous waste regulations and definitions, see 40 CFR Part 261 -- Identification and Listing of Hazardous Waste.)

5. Potential Use: How widely is the process used in the Armed Services? Would the process modification have widespread application?

Notice that the five criteria do not judge the success (or lack thereof) of a given modification. The five criteria were used in Phase 1 to determine which cases would be most valuable for further study in Phase 2. They were also used in Phase 2 to select three Projects of Excellence for the Phase 3 workshops.

The evaluation of whether or not a process modification was successful was separated from the determination of its value as an example for further analysis. To determine if a modification was successfully applied, it was determined whether or not the modification had been implemented as proposed, proved cost-effective, and was sustainable or capable of being carried on indefinitely. Modifications that met these criteria were classified as successful (S). Those process modifications found not to be successful (U) failed for a variety of reasons, which are explained in footnotes (a through m) to Table 1.2. Those modifications for which insufficient information was available, or for which implementation was too early in progress to evaluate, are designated with an N; and the rationale for this designation is also explained in footnotes to Table 1.2.

The 18 cases recommended for further evaluation included 13 that were successful and 5 that were not. By service, there were 3 Army, 6 Air Force and 9 Navy cases, approximately proportional to the distribution of the original 40 cases.

By industrial process, 7 of the cases involved modifications to plating operations, 5 were for modifications to painting or paint stripping, 5 were for modifications to recover solvent, and 1 was to modify purchase and use specifications to reduce disposal of items whose shelf life had expired. Selection of these cases fulfills the objective of the contract to "...focus on a few processes that generate the greatest proportion of DoD hazardous wastes..."

Among the 18 cases, there were numerous candidates for the three "Projects of Excellence" to be selected during Phase 2 of the project.

1.4.2 Phase 2: 18 Case Studies

During Phase 2 of the project, 18 case studies were further evaluated and three Projects of Excellence were selected. Since it was extremely difficult to obtain information about Case No. 23 (Modern Plating System at Watervliet Army Arsenal) and Case No. 40 (Purchase and Use Specifications), they were replaced with two additional Army case studies at the beginning of Phase 2. These process modifications are the Centralized Vehicle Wash Racks and Scheduled Maintenance Facilities at Fort Lewis and Fort Polk (Case Nos. 41 and 42).

The 18 case studies were ranked according to their study value and application success as shown in Table 1.3 (Table 6-1 from the CH2M HILL Phase 2 Report). The three top-ranked cases were selected for Phase 3.

TABLE 1.3 Phase 2 Evaluation of 18 Case Studies

TABLE 6-1 EVALUATION OF CASE STUDIES

REPORT SECTION	FACILITY, MODIFICATION	STUDY VALUE					STUDY SCORE	APPLICATION SUCCESS											SUCCESS SCORE	TOTAL SCORE
		A	B	C	D	E		F	G	H	I	J	K	L	M	N	O			
3.4.1	HILL AFB, DRY PAINT STRIPPING	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	9.5	19.5	
4.4.3	PENSACOLA NARF, SPRAY RINSE	1.0	1.0	1.0	1.0	1.0	10.0	1.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0	9.5	19.5	
5.4.2	FORT LEWIS ARMY, VEHICLE WASHRACKS	1.0	1.0	1.0	0.5	1.0	9.0	1.0	1.0	1.0	0.5	1.0	1.0	1.0	1.0	1.0	1.0	9.5	18.5	
3.4.6	ROBINS AFB, SOLVENT RECYCLE	1.0	1.0	1.0	1.0	1.0	10.0	0.5	0.5	1.0	0.5	1.0	1.0	1.0	1.0	1.0	0.5	8.0	18.0	
3.4.2	PENSACOLA NARF, DRY PAINT STRIPPING	0.7	1.0	1.0	1.0	1.0	9.4	1.0	1.0	1.0	1.0	0.5	0.5	1.0	0.5	1.0	1.0	8.5	17.9	
5.4.1	FORT POLK ARMY, VEHICLE WASHRACKS	0.7	1.0	1.0	0.5	1.0	8.4	1.0	1.0	1.0	0.5	0.5	1.0	1.0	1.0	1.0	1.0	9.0	17.4	
3.4.7	NORFOLK NSY, SOLVENT RECYCLE	1.0	0.5	1.0	1.0	1.0	9.0	0.5	0.5	1.0	0.0	1.0	1.0	1.0	1.0	1.0	0.5	7.5	16.5	
4.4.5	ANNISTON ARMY DEPOT, PLATING	0.7	1.0	0.7	1.0	1.0	8.8	0.5	0.5	1.0	0.5	0.5	0.5	0.5	1.0	1.0	1.0	7.0	15.8	
3.4.3	PENSACOLA NARF, WATER PRIMER	1.0	0.5	0.7	1.0	1.0	8.4	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	7.0	15.4	
3.4.5	HUGHES (USAF), POWDER COATING	1.0	0.5	0.5	1.0	1.0	8.0	1.0	1.0	1.0	0.0	0.5	0.5	0.5	1.0	0.5	1.0	7.0	15.0	
4.4.2	LOCKHEED (USAF), Cd PLATING	1.0	0.5	0.7	1.0	1.0	8.4	0.5	0.5	0.0	0.5	0.5	0.5	1.0	1.0	1.0	1.0	6.5	14.9	
3.4.10	ANNISTON ARMY DEPOT, SOLVENT RECYCLE	1.0	0.5	0.7	1.0	1.0	8.4	0.0	0.5	1.0	0.0	1.0	1.0	1.0	0.5	0.5	0.5	6.0	14.4	
3.4.4	LOCKHEED(USAF), PAINTING	0.7	0.3	1.0	1.0	1.0	8.0	0.5	0.5	1.0	0.0	0.5	0.5	1.0	0.5	0.5	1.0	6.0	14.0	
3.4.8	TYNDALL AFB, SOLVENT RECYCLE	0.7	1.0	1.0	1.0	1.0	9.4	0.5	0.5	0.5	0.0	0.5	0.5	0.5	0.5	0.5	0.0	4.0	13.4	
4.4.6	TOBYHANNA ARMY DEPOT, WASTE TREATMENT	1.0	0.5	0.7	1.0	1.0	8.4	0.5	0.5	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	3.5	11.9	
3.4.9	NORFOLK NARF, HEPTANE RECYCLE	1.0	0.7	0.7	1.0	1.0	8.8	0.5	0.0	0.0	0.0	0.5	0.0	0.5	0.5	0.5	0.0	2.5	11.3	
4.4.1	NORTH ISLAND NARF, IVD OF ALUMINUM	1.0	0.7	0.7	1.0	0.7	8.2	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	2.5	10.7
4.4.4	CHARLESTON NSY, LICON CHROME RECOVERY	1.0	0.5	0.7	1.0	0.7	7.8	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	1.0	0.0	2.5	10.3

WEIGHTING VALUE

0.0

1.0

STUDY VALUE

NOTE: Each modification was assigned a score for each of fifteen criteria. The criteria applied and the scores possible for each criterion are shown below. Five of the criteria are to determine the example value of the case, or potential for reducing hazardous waste, if successfully applied. Double the sum of these values is used to compute the "Study Score." The second ten criteria were used to evaluate the success of the modification and potential for successful application at other DOD facilities.

A CONCRETE EXAMPLE

B WASTE REDUCTION

C WASTE GENERATION

D EPA HAZWASTE

E POTENTIAL USE

APPLICATION SUCCESS

F ENERGY USE

G MANPOWER

H MATERIAL COSTS

I CAPITAL COSTS

J MAINTAINABILITY

K RELIABILITY

L SIMPLICITY

M STAFF ENTHUSIASM

N MANAGEMENT

O PRODUCT IMPACT

QUESTIONABLE

MODERATE

MODERATE

SOMETIMES

LIMITED

WIDESPREAD

LOWER

LOWER

LOWER

LOWER

EASY

HIGH

SIMPLE

CHAMPION

SUPPORTIVE

FAVORABLE

NO

MINOR

MINOR

NO

UNIQUE

HIGHER

HIGHER

HIGHER

HIGHER

HARD

LOW

COMPLEX

INDIFFERENT

INDIFFERENT

NEGATIVE

Source: CH2M HILL, July 1985.

1.4.3 Phase 3: 3 Projects of Excellence

As a result of all the evaluations the following three case studies were selected as the most appropriate to fulfill the overall goals of this project:

1. Plastic Media Paint Stripping at Hill Air Force Base, Ogden, Utah.
2. Innovative Hard Chrome Plating at Pensacola Naval Air Rework Facility, Pensacola, Florida.
3. Centralized Vehicle Wash Racks and Scheduled Maintenance Facilities at Fort Lewis, Washington.

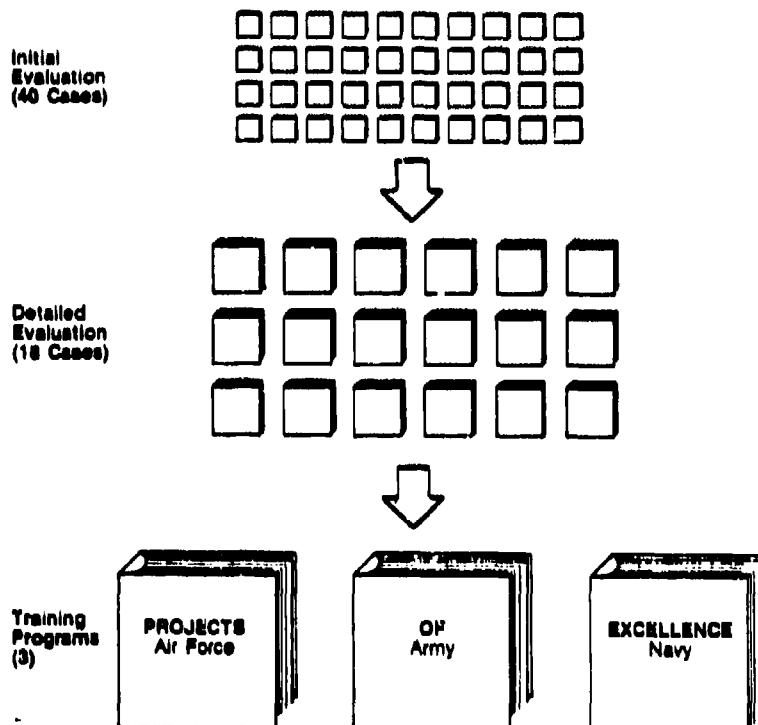
Plastic media paint stripping at Hill Air Force Base was selected for the following reasons:

1. Widespread DoD adoption has the potential of reducing the costs of operation by at least \$100,000,000 per year, a significant internal incentive to production and management people to implement this change.
2. Adoption of the process would eliminate one of the major liquid hazardous waste sources in the armed services.
3. Its applicability is widespread, potentially applicable at every military installation.
4. The process is easy to operate and involves adaptation of conventional technology.
5. From a production standpoint, manpower requirements are significantly reduced, product quality is improved, and production costs are significantly decreased.

The zero discharge chromium plating system, developed at Pensacola NARF by the Naval Civil Engineering Laboratory (NCEL) at Port Hueneme, likewise combines the incentives of production improvement with reduced hazardous waste production. The process is also widely applicable. From a production standpoint, rejection rates are drastically reduced, plating rates are increased, and fewer plating baths are required to plate the same number of parts. In addition, frequency of plating bath dumps has been reduced and industrial wastewater treatment has been simplified.

INDUSTRIAL PROCESSES

To Reduce Generation of Hazardous Wastes At DOD Facilities



Case Distribution

Category	Phase 1 (40)	Phase 2 (18)	POE (3)
Paint Stripping	4	2	1
Solvent Cleaning	10	7	1
Plating	13	6	1
Painting	5	3	—
	32	18	3

Technology Elegant in Its Simplicity

- Plastic Media Paint Stripping
- Solvent Recovery Stills
- Vehicle Wash & Maintenance
- Spray Rinse System

The central vehicle washracks and vehicle maintenance facilities at Fort Lewis, Washington, were selected principally for their segregation of exterior vehicle washing from vehicle maintenance and engine compartment cleaning. Conventional cleaning with cold water, solvents, and detergents on open pads resulted in a significant contamination of stormwater. The modification uses off-the-shelf high pressure hot water cleaning equipment for engine compartment cleaning, eliminating the use of solvents and greatly reducing the volume of waste requiring treatment. The overall system has also greatly reduced the manpower requirements for vehicle cleaning. Significant cost savings are projected compared to the previous operation.

During Phase 3, two-day workshops are being developed and given at each of the three sites. The workshops are designed for decision-makers in each of the three services, including managers, engineers, and operators who are responsible for similar military industrial processes at other facilities. The goal of the training programs is to give firsthand knowledge of highly successful process modifications and an understanding of why they have been successful, so that participants will be even better equipped to take the lead in adopting similar process modifications at their own facilities.

1.5 General Recommendations for Successful Process Modifications

Based on the case study analysis in Phases 1 and 2 of this report, the following recommendations were made for enhancing the likelihood of success for future process modifications:

1. Identify the potential advantages and disadvantages of including the costs of hazardous waste disposal in production budgets so that they will be used in production decisions.
2. Investigate the possibility of providing incentives for hazardous waste reduction efforts (e.g., returning money not spent on disposal to the base recreation and welfare fund).

3. Include production people in the design effort; since they will be left to operate the modified process, they need to feel that it is theirs.

4. Ensure that environmental effects are considered as important as production when conflicts between the two arise. It may be desirable to make environmental rating one of the evaluation criteria for the base commander.

5. Ensure that adequate funding is provided to support wider adoption of proven process modifications.

6. Ensure that appropriate adaptations are made to all technologies (even off-the-shelf systems) before transferring them to facilities where they have not been tested; thus, each technology will be "tailored" to the individual facility.

7. In view of the typically high turnover rate among operations personnel, ensure that a sufficient number of personnel are trained to provide back-up operation when necessary.

8. Ensure that the data collected to predict costs and benefits of a particular technology are accurate, valid, and sufficient.

9. Ensure that design personnel devote sufficient time, after equipment installation, to inspecting the system for proper operation and maintenance.

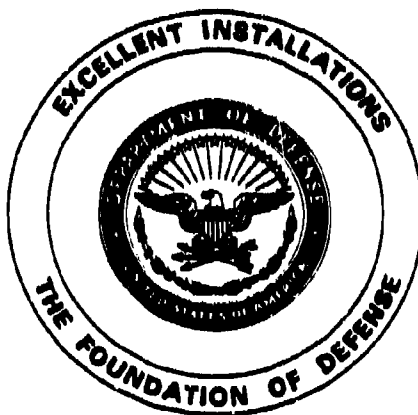
10. In considering locations for future demonstration studies, select only facilities where the responsible personnel are enthusiastic about the study.

11. In conducting future demonstration studies, ensure that sufficient manpower is assigned and that the personnel are adequately trained, well supervised, and not fully committed to other projects.

12. Whenever possible, make adaptations to off-the-shelf equipment with a proven record of reliability rather than selecting specialized or complicated equipment.

Again, welcome to Hill Air Force Base for the Project of Excellence Workshop on Plastic Media Paint Stripping. The remaining sections of these training materials discuss numerous technical, environmental, and economic aspects of this highly successful project to reduce hazardous waste generation from paint stripping operations at DoD facilities.

Presented by Richard Boubel, Project Officer, DELP



DEFENSE ENVIRONMENTAL LEADERSHIP PROJECT

INAUGURATED JANUARY 1984

REPORTS TO THE DIRECTOR OF ENVIRONMENTAL POLICY, OASD

PURPOSE

- o TO IMPROVE COMPLIANCE
- o TO REDUCE WASTE

PRESS RELEASE

DEFENSE ENVIRONMENTAL LEADERSHIP PROJECT

Environmental protection is a multi-billion dollar DoD effort. Non-compliance with environmental laws and regulations will adversely impact DoD operations, resources and Congressional support. DoD is the largest federal generator of hazardous wastes, and the public, news media and Congress view environmental protection from hazardous wastes as a high national priority. Environmental protection cannot be avoided or ignored. The nuclear power industry, for example, used the best engineering, planning and economic talent available. The one area overlooked, environmental protection, ultimately crippled the industry.

The environmental leadership project was initiated to provide DoD a needed resource for long-range planning and policy development. The project has undertaken 18 tasks which can be grouped broadly under "compliance" and "waste stream reduction". Compliance is necessary to avoid crippling our installations and production base, and waste stream reduction will reduce disposal costs and future disposal-related problems.

The leadership project approach of planning to avoid problems will ensure least cost compliance. Resources not required for environmental protection are freed for other Defense programs. Effective planning and management are used to identify and solve problems before they become more costly. Environmental protection need not be complex and costly, if handled properly.

The project team is dealing with some tough environmental issues -- problems like groundwater protection, solvent recovery, regional hazardous waste treatment, hazardous waste storage construction criteria, environmental audits, and low-level radioactive waste disposal. These and future issues will improve significantly DoD's national leadership position in environmental protection and avoid the pitfall of non-compliance.

INDUSTRIAL PROCESS MODIFICATION TO
REDUCE HAZARDOUS WASTE GENERATION

- o PHASE I - STUDY OF EXISTING INFORMATION
- o PHASE II - IN-DEPTH ANALYSIS OF A FEW DOD
INDUSTRIAL PROCESSES
- o PHASE III - SELECT ONE PROCESS FROM EACH SERVICE
AS A DEMONSTRATION PROJECT OF EXCELLENCE

DOD NEEDS AN INCENTIVES PROGRAM FOR HAZARDOUS WASTE
REDUCTION/RECYCLING

- o TO PROVIDE UP-FRONT MONEY FOR WASTE
REDUCTION PROJECTS.
- o TO RETURN BENEFITS TO THE INSTALLATION
COMMANDER.

FUNCTIONAL DESCRIPTION OF THE ENVIRONMENTAL, PRODUCTIVITY
ENHANCING CAPITAL INVESTMENT (PECI) PROGRAM



THE DEPARTMENT OF DEFENSE

**PRODUCTIVITY ENHANCING
CAPITAL INVESTMENTS
PROGRAM STATUS REPORT**

**PREPARED BY
THE DEFENSE PRODUCTIVITY PROGRAM OFFICE
FOR THE
ASSISTANT SECRETARY OF DEFENSE
FOR
MANPOWER, INSTALLATIONS AND LOGISTICS**

MARCH 1984

EXECUTIVE SUMMARY

The Department of Defense (DoD) is pleased to report, once again, on the status and achievements of the DoD Productivity Enhancing Capital Investment (PECI) Program. In addition to providing specific information on this program, this report will describe the relationship of the PECI Program to many other DoD productivity initiatives, ranging from established programs for employing modern industrial and management engineering techniques to the Department's relatively new emphasis on work force motivation and efficiency reviews.

The Department is very proud of its efforts. Since the initiation of the PECI Program in 1977, a broad range of avenues for productivity improvement have been investigated and pursued. Many have become institutionalized in DoD management practices. Others are promoted as "self-help" tools whereby managers can cope with the demands of increasing technology and constrained or diminished resources. The Department recognizes that if it is to be effective in maintaining a strong and ready Defense force, it has a commensurate responsibility to do this in the most efficient manner -- a process which means getting the greatest return from the dollar and manpower resources provided by the American taxpayer. DoD's PECI Program is a very necessary effort to this end with a demonstrable impact.

Initially started as a means of capitalizing on small dollar quick return investment opportunities, the PECI Program has since evolved into a broad strategy for productivity improvement. As presently structured, it involves three distinct but directly related funding strategies -- the Productivity Enhancing Incentive Fund (PEIF) for small dollar quick return equipment projects; the Productivity Investment Fund (PIF) which focuses on larger long-term investments with a payback period of four years or less; and Component Sponsored Investment (CSI) funding which complements the OSD-sponsored PIF but is more flexible to react to goals and priorities of the individual Military Service or Defense Agency. Projects financed through each of these funds are selected competitively on the basis of their economic merit and an assessment of their technical and operational potential.

Together these three funding strategies have invested a total of \$605 million over the past four years to acquire modern technologies and facilities. The savings from these investments are expected to total over \$3.0 billion by 1990, through either direct reductions in Defense budget requests or by allowing DoD managers to plow back savings and thereby accomplish increased missions or attack critical backlogs within fixed resource limitations. Equally as important, these PECI funds have become a cornerstone in many of the Department's other productivity initiatives by

providing ready and dedicated financing for opportunities identified through the Commercial Activities, Efficiency Review and Work Force Motivation Program. PECIs have also served as an avenue to foster infusion of high technology projects into the Defense operational mainstream. Funds have been provided for such wide-ranging projects as DoD's Logistics Applications of Automated Marking and Reading Symbols (LOGMARS) project involving the use of machine readable bar coding in logistics activities and the installation of technologies developed through the Manufacturing Technology Program in the repair of sophisticated weapons systems. Modern equipment has also been procured for the Defense laboratories, enabling them to greatly improve the testing of new materials and systems at significantly lower costs.

Statistics on the PEI Program are impressive. Visible support by top DoD management, a sharp focus on high-payoff investments, and an ultra-conservative level of funding have resulted in a continuing increase in the expected level of returns from PECIs. Savings to investment ratios for the fast payback PEI investments have grown from approximately \$10 to \$1 for Fiscal Year (FY) 1977 investments to \$13 to \$1 for FY 1983 investments. Many of the individual investment projects return about \$15 for each dollar invested during their average nine year life span. The larger PEI investments, because of their longer expected life, have shown a much greater growth in expected savings. First funded in 1981, the savings to investment ratios have dramatically increased from 6 to 1 in that year to 14 to 1 for projects included in the FY 1984 Budget request. Projects now in the FY 1985 Budget reflect a ratio of 22 to 1, with an expected internal rate of return of over 80 percent.

In addition to the tangible benefits from PECIs, which include expected manpower savings of over 17,500 spaces, these investments have also produced a variety of intangible benefits such as improved work methods and conditions, increased ability to cope with complex and mounting workloads, and motivation for innovative productivity enhancing actions.

The program complements DoD's Asset Capitalization Program (ACP) in industrially funded activities and planned modernization efforts across the Department. More importantly, it recognizes and acknowledges the fact that the Department's greatest asset is the initiative shown by its people. PEI has received the full support of Defense management at all levels. With its present maturity, it is deserving of the support of the Congress for it represents concrete evidence of DoD's ability to achieve tangible economies through a judicious investment policy.

Contact: Mr. Richard J. Power, Director
Defense Productivity Program Office
2 Skyline Place, Room 1404
5203 Leesburg Pike
Falls Church, Virginia 22041-3466
Phone: (703) 756-2346

2.0 PROJECT DESCRIPTION

- 2.1 Paint Stripping Process Description
- 2.2 Magnitude of the Problem
- 2.3 Alternative Approaches to Plastic Media Paint Stripping
- 2.4 Process Variables and Constraints
- 2.5 Project History
- 2.6 The F-4 Blast Booth at Hill Air Force Base

- Components
 - Blast Booth
 - Equipment Room
 - Blasting System
 - Work Platforms
 - Modifications to Existing Equipment
 - Capital Costs
 - Operation and Maintenance Costs

Presentation by Bob Roberts, Project Developer

2.0 PROJECT DESCRIPTION

The Project of Excellence for the U.S. Air Force is the concept of replacing conventional military paint stripping with plastic media paint stripping to improve productivity and greatly reduce hazardous waste generation. There are many ways in which this concept can be applied. This section describes the paint stripping process, the magnitude of the existing problem, alternative approaches to plastic media paint stripping, and how this concept is being applied at Hill Air Force Base.

2.1 Paint Stripping Process Description

Paint stripping is the process of removing paint and coatings from surfaces in preparation for recoating. Complete stripping is often necessary for inspection of underlying materials and for adhesion of new paint and coatings to existing surfaces.

In conventional military paint stripping, sprays or baths containing acidic methylene chloride solutions, phenolic solutions, or hot alkaline sodium hydroxide solutions are used to dissolve and loosen old paint. After scraping, the resulting solvent-paint mixture is washed away with large volumes of water, producing significant quantities of hazardous waste. The process is labor intensive, dirty, and may overload waste treatment facilities.

In plastic media paint stripping, small plastic beads with rough edges are air blasted at the painted surface causing the coating to dislodge. The plastic media is separated from the loosened paint particles by sieving, and the beads are recycled. Generation of wet hazardous waste (solvents and paint sludge in water) is completely eliminated. A small volume of dry waste is produced, which is classified as hazardous due to its metal content.

2.2 Magnitude of the Problem

Paint stripping operations are performed at virtually every DoD industrial facility across the United States. To illustrate the magnitude of the problem of hazardous waste generation from these operations, previous studies have estimated that each naval shipyard generates about 9,000,000 gallons of paint solvent waste each year. Approximately 20,000 gallons of solvent-laden wastewater is generated for each military aircraft which has paint removed using conventional methods.

The Department of the Air Force, including the U.S. Air Force, Air National Guard, and Air Force Reserve, has nearly 10,000 aircraft of all types currently in service, as shown by Table 2.1. The average age of all aircraft as of September 30, 1984, was slightly more than 13 years. With an average time between Planned Depot Maintenance (PDM) of about five years for many aircraft, plus requirements for unplanned maintenance, there could be a need to strip paint from 2,000 or more aircraft per year.

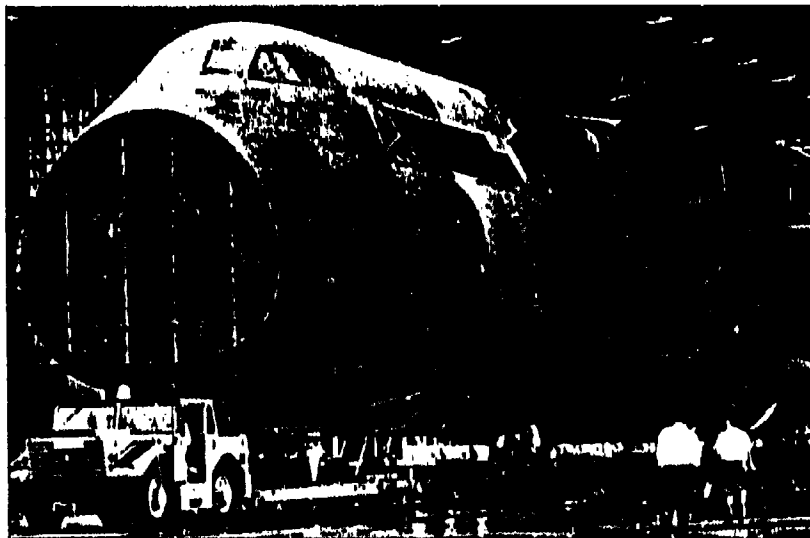
Table 2.1
NUMBER AND AGE OF SELECTED AIRCRAFT
IN THE U.S. AIR FORCE, NATIONAL GUARD, AND RESERVE
(September 30, 1985)

<u>AIRCRAFT</u>	<u>NUMBER</u>	<u>AVERAGE AGE</u>
A-7	382	11.2
A-10	670	4.5
B-52	264	24 +
C-130	723	19.4
C-131	747	23.6
F-4	1621	16.4
F-15	697	5.3
F-16	723	2.5
F-111	339	13.4
T-37	615	22.2
T-38	820	18.5
ALL TYPES	9462	13.2

Source: Air Force Almanac, May 1985.

★ The first C-5B being assembled at Lockheed-Georgia Co., Marietta, Ga., entered the final assembly stage in April and has been painted in the new "European I" camouflage pattern of a gray background and shades of green and olive trim. This replaces the gray-and-white paint scheme on many C-5As. The C-5A fleet will be in the new paint by 1988.

In painting the first giant C-5B fuselage, Lockheed used fifty-six gallons of primer, ninety-five gallons of gray, and forty gallons of varying shades of green. The first C-5B will be delivered to the US Military Airlift Command in December. Production will peak in early 1987, when a new Galaxy will roll out the plant door every ten working days. The fiftieth and last aircraft is scheduled to be delivered in the first quarter of 1989.



Sporting the new European I camouflage paint scheme, the fuselage of the first Lockheed C-5B military transport rolls out of the company's huge paint hanger. Delivery to the US Military Airlift Command is scheduled for December.

AIR FORCE Magazine / May 1985

Currently, the Ogden Air Logistics Center at Hill Air Force Base strips paint from only a portion of the 300+ aircraft which it receives each year because of the time and expense required for conventional paint stripping. Aircraft are stripped if they have more than six coats of paint, if the paint condition does not meet certain standards, if a certain type of paint needs to be replaced, or if inspection procedures require paint removal.

In addition to complete aircraft which are in service, paint removal is occasionally required for aircraft which are on display or in storage, motor vehicles, and other weapons and equipment. Paint removal from system components is also frequently necessary.

2.3 Alternative Approaches to Plastic Media Paint Stripping

The following factors and other site-specific conditions and requirements determine what type of equipment and facilities will be best suited for plastic media paint stripping at a specific location:

1. The size, shape, and composition of the objects to be stripped. Are they aircraft components or complete aircraft, small fighter aircraft or large bombers, fixed or rotary wing? What type of surfaces do they have?
2. The frequency of the same stripping operation at the same location. Will it be one aircraft per day or one aircraft per month?
3. Time and manpower available. How fast does each item need to be stripped and how many qualified people are available to do it?
4. Occupational health and safety and environmental considerations. These are discussed in Section 6.0.
5. The economics of media recovery. Since plastic media is relatively expensive (\$1.70/pound) and only about 5% is lost during each use, recycling is practiced. Should media recovery be done by hand or by some type of material handling system? How will the paint chips and dust be separated from the recovered media?
6. Separation from water. Since water causes the plastic media to agglomerate, the paint stripping and media recovery operations should be

separated from vehicle washing operations. The media should also be protected from precipitation and condensation.

Equipment and facilities for plastic media paint stripping currently range in size and complexity from small portable blast machines with one hose and no media recovery to the F-4 blast booth with five hoses and automatic media recovery at Hill Air Force Base. Several types of abrasive blasting equipment, with and without media recovery, are described in the manufacturers' literature in Appendix 3. Glove boxes with vacuum recycling can be used for small components. Appendix 2.3 describes how the basic F-4 blast booth module could be used for more aircraft, larger aircraft, and ground equipment.

Alternative approaches for plastic media recovery include the following:

1. Manual collection with brooms and shovels on a flat surface.
2. Manual collection to a central pit or trench with conveyor or vacuum recovery.
3. Mechanical or pneumatic collection over a large area, such as the live floor of the F-4 blast booth.
4. Blast nozzles with recovery systems.
5. Glove boxes with recovery systems.

Each of these approaches has advantages and disadvantages which depend on the application. Each technology for plastic media paint stripping presents tradeoffs between capabilities and costs.

2.4 Process Variables and Constraints

Operators of plastic media stripping equipment must be skilled enough to avoid damaging the surface from which paint is being stripped. In fact, the greatest drawback to this technique is the difficulty in selecting and controlling the variables for each application, including bead hardness, roughness and size, motive air pressure, standoff distance, application

angle, nozzle size, feed rate, etc. This task is especially difficult with fiberglass resin surfaces. The type of resin which is present usually cannot be pre-identified. Damage to the fiberglass surface is possible if the wrong media or method is used to strip the coating.

The key parameter for successful use of plastic media blasting is hardness - the paint must be softer than the plastic media, which in turn must be softer than the surface underneath the paint coat. For many military paint stripping applications, this relationship does not exist. For example, epoxy and urethane paints are harder than aluminum surfaces and dry blasting is not applicable. This problem could be alleviated by presoftening the paint with a solvent and allowing the treated surface to dry prior to blasting. However, this use of solvents defeats the advantage of dry blasting and could not be carried out with a live floor recovery system.

There are several measures of hardness as shown in Table 2.2. Moh's scale has been used to describe the relative hardness of substrates, paints, and abrasive materials involved in paint stripping. Table 2.3 compares the relative hardness of abrasive materials (on the right) to paints and substrates (center) and to Moh's hardness scale of 1 to 10 and the minerals which are now commonly associated with the scale.

Table 2.2

HARDNESS SCALES FOR MATERIALS

<u>HARDNESS</u>	<u>SCALE</u>	<u>MATERIALS</u>
INDENTATION	BRINELL	METALS AND ALLOYS
REBOUND	ROCKWELL	PLASTICS
SCRATCH	MOHS	MINERALS
CUTTING		
ABRASION		

Table 2.3

HARDNESS OF MATERIALS (MOH'S SCALE)

10	DIAMOND		SILICON CARBIDE
9	CORUNDUM		
8	TOPAZ OR BERYL		ALUMINA ZIRCONIA
7	QUARTZ	PORCELAIN TOOL STEEL	GARNET
6	FELDSPAR		SILICA
5	APATITE	ANODIZE TITANIUM	GLASS STEEL
4	FLUORITE	MAGNESIUM	TYPE III
3	CALCITE	PAINT, FIBERGLASS RESINS, KEVLAR	POLYPLUS POLYEXTRA
2	GYPSUM	ALUMINUM	AGRI-MEDIA
1	TALC		

Experience at Hill AFB has suggested the following Moh's scale values for materials typically encountered in aircraft paint stripping:

<u>Material</u>	<u>Moh's Scale Hardness</u>
Anodized aluminum	5.4
Steel, stainless steel, titanium	5 - 5.5
Magnesium	3.8
Fiberglass, molded dense resin*	3.5
Paint	3.3 - 3.4
Fiberglass, hand laid less dense resin*	3.2
Kevlar*	3
Alclad, dead soft aluminum	2.73

* Polyester resins are softer than epoxy resins

Note: Composite materials are damaged if the resin is eroded and the fibers, such as fiberglass, nylon, or carbon graphite, are exposed.

The manufacturer's literature in Appendix 3 lists the following hardnesses for the three types of plastic media currently available:

<u>Plastic Media</u>	<u>Moh's Scale Hardness</u>
Type III	4.0
Polyplus	3.5
Polyextra	3.0

Ideally, each material could be ranked higher on Moh's scale than every other material which it can scratch or abraid. However, a number on Moh's scale does not necessarily reflect other characteristics of materials, such as cohesive and adhesive strength, elasticity, malleability, durability, and thickness. In addition, materials may have a range of hardness values rather than a unique number. Resistance to abrasion also depends on the force and length of time with which abrasive materials are applied.

Quality control tests and measurements are required to determine whether specific blast media and application methods are appropriate for specific paints, coatings, and substrates. The data base on plastic media paint stripping is expanding rapidly as the process is tested and implemented at more locations. Efforts are being made to incorporate this information into the appropriate technical orders for aircraft maintenance.

2.5 Project History

Table 2.4 summarizes the history of aircraft paint stripping at Ogden ALC from construction of the Corrosion Control Building in 1957, through research and development of plastic media paint stripping beginning in 1979, to construction of the F-4 blast booth in 1985. More details concerning the development of the project are given in the references contained in Appendix 2 and in many of the other references listed in the Bibliography.

Table 2.4

PROJECT HISTORY

1957	CORROSION CONTROL FACILITY BUILT PHYSICAL AND CHEMICAL PAINT REMOVAL
1979	R & D WORK BEGAN ON BLAST MEDIA AGRICULTURAL PRODUCTS PLASTIC BEADS AIRCRAFT COMPONENT TESTING
JUL 1983	PRAM PROJECT APPLICATION F-100 FIRST PLANE STRIPPED & PUT ON DISPLAY
JUN 1984	CONTRACT AWARDED FOR F-4 BLAST BOOTH
JUL 1984	CONSTRUCTION BEGAN OF F-4 BLAST BOOTH PAINT REMOVED FROM FIRST F-4 USING PLASTIC MEDIA
MAY 1985	FIRST F-4 STRIPPED IN BLAST BOOTH DEDICATION OF NEW FACILITY F-102 STRIPPED FOR HERITAGE MUSEUM
AUG 1985	DELP WORKSHOP ON PLASTIC MEDIA PAINT STRIPPING
1986	ADDITIONS AND ALTERATIONS TO CORROSION CONTROL FACILITY

Most of the new facility was funded by the Air Force PRAM Program. PRAM stands for "Productivity, Reliability, Availability, and Maintainability." PRAM funds are available for one-of-a-kind research and development projects which are likely to contribute to one or more of these four goals at Air Force installations. A comprehensive report on the whole PRAM project will be completed when the F-4 facility is turned over from development to production.

DEDICATION OF THE F-4 BLAST BOOTH ON MAY 10, 1985

Base's new paint blaster is non-toxic

Process uses plastic beads and strips faster, cheaper

By Don Rosebrock
Deseret News staff writer

HILL AIR FORCE BASE — Facilities that will house a new paint removal process developed at Hill Air Force Base — a process that its inventor believes will save more than \$5 million in its first year of use — were dedicated Friday.

The process uses plastic beads, instead of toxic chemicals, blasted against a painted surface under pressure.

It was developed over four years of research by Robert A. Roberts, Layton, a lead engineering technician in the Directorate of Maintenance's aircraft division.

Besides eliminating toxic chemicals, the process reduces stripping time.

Friday's ceremony, in which Rep. Jim Hansen, R-Utah, cut a huge plastic ribbon draped across a freshly stripped F-4 Phantom, was attended by about 50 defense and Air Force officials.

After praising the innovation and research that went into developing the process, Hansen donned a protective hood and picked up a nozzle, blasting the paint off a purple-hued tail section set up for the ceremonies.

Pointing to the stripped jet behind him, Roberts said its paint was cleaned off with 25 manhours of work compared to the previous time of 296 manhours.

It now takes some 500 gallons of potent, highly toxic chemicals to strip the paint off a jet fighter, Roberts said. That must be mixed with between 25,000 and 30,000 gallons of water for disposal in a toxic waste dump.

Roberts said the aircraft division bought more than \$1 million in steam last year to aid in paint stripping, compared to the \$65 per day in electricity he said it costs to operate the

new facility.

The costs savings should amount to \$5.2 million the first year alone, he estimated.

Roberts said he began researching a new method of stripping four years ago when the Environmental Protection Agency began clamping down on disposal of toxic wastes.

He looked at materials ranging from walnut shells to peach and apricot pits as stripping agents, he said, but found problems with all of them. Then, he hit on plastic.

The material he uses resembles white sand but is actually the leftovers from the manufacture of plastic clothing buttons.

"This is the greatest stuff," Roberts said Friday, yanking the lid off a barrel in a corner of the stripping room, and pouring it into the hands of everyone around him.

"It's non-abrasive, non-allergenic, and there's no silica in it. It's not a growth medium, which is a problem with walnut shells. With walnut shells, you get a particular strain of salmonella that grow in it.

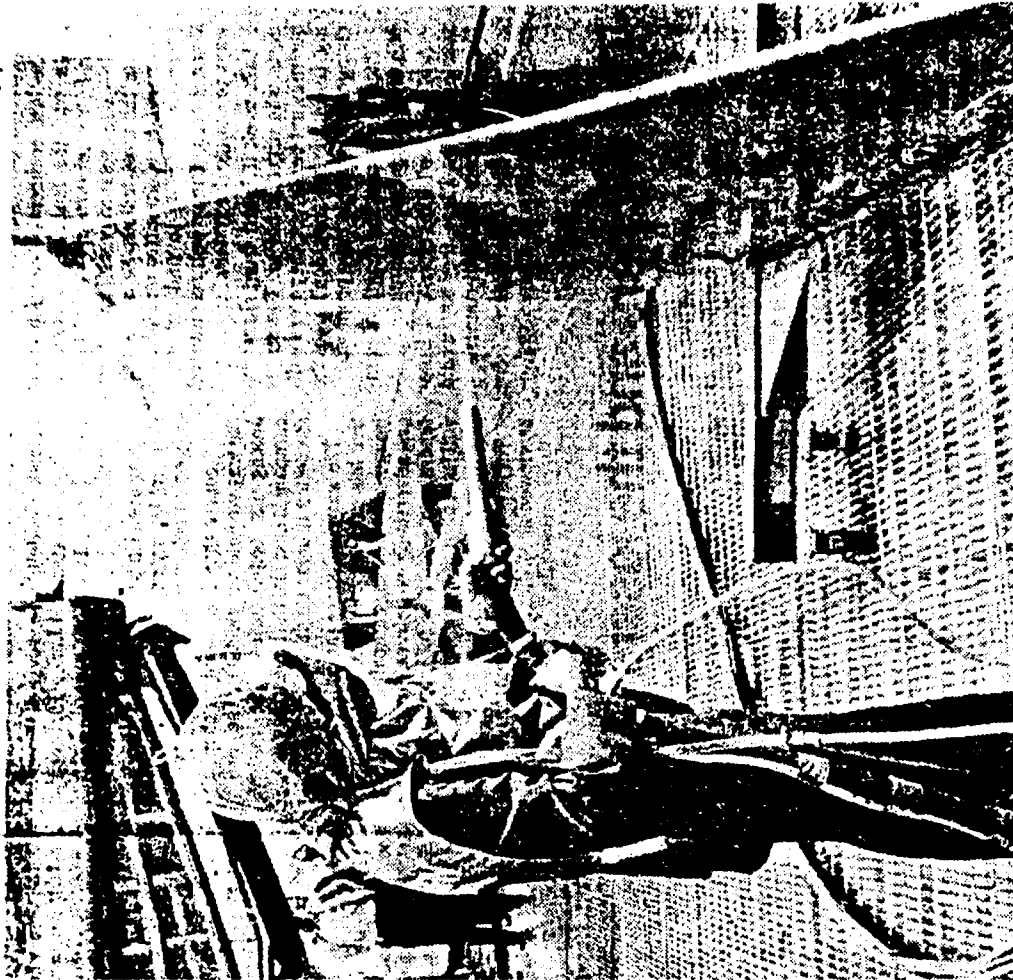
"Then, when you blast it against something, you spread that salmonella and dust all through the air and people breathe it," said Roberts.

"You just don't have those problems with this stuff," he said, now handing out small plastic sample bags to reporters and onlookers.

The plastic sand is blown through nozzles at 40 pounds of pressure and can strip two square feet of surface in a minute. A year's supply will cost \$24,000 compared to \$585,000 for chemicals to do the same job.

The stripping is done in a specially designed and pressurized building with a floor of steel mesh and gridwork punctuated by 6,700 holes.

When the system is activated, air pressure from the ceiling drives the air blasting material and stripped paint



PHOTOGRAPHY/DON ROSEBROCK

Rep. Jim Hansen, R-Utah, blasts the paint off an aircraft tail section with plastic beads.

down to the floor where it falls through the holes.

A recovery system separates the pulverized paint from the plastic, which is recycled through the nozzles. It can be reused a dozen times or more, Roberts said.

Although the facility dedicated at Hill Friday is the first of its kind in the world, Roberts said other military bases have already looked it over and are planning their own.

Commercial airlines are interested in strip a van belonging to the base fire department next week in 15 minutes also looking at the technology. His system can strip the paint from a pickup truck in just over an hour without having to mask windows or chrome and Roberts said he plans to strip a van belonging to the base fire department next week in 15 minutes.

2.6 The F-4 Blast Booth at Hill Air Force Base

The purpose of the new facility is to remove paint from F-4 aircraft. The facility, as shown in Figure 2.1, is a prefabricated steel building with the following components and accessories:

1. Access doors
2. Observation booth (added since drawing was prepared)
3. Plastic media supply system
 - Plastic media storage hopper
 - Air compressor and refrigerated drier
 - Blast generators
 - Blast hoses and lighted nozzles
 - Small parts blasting area
4. Plastic media recovery system
 - Support and recovery floor
 - Flex connectors
 - Manifolds
 - Main recovery pipes
 - Dust collector
 - Classifier
 - Rotary feed valves
5. Ventilation system
 - Fresh air supply inlet
 - Heating coil and fan
 - Downdraft registers
 - Dust collector
6. Utility services
 - Transformer
 - Electrical control panel
 - Utility air
 - Central Vacuum
 - Wall and ceiling lighting
 - (No water)

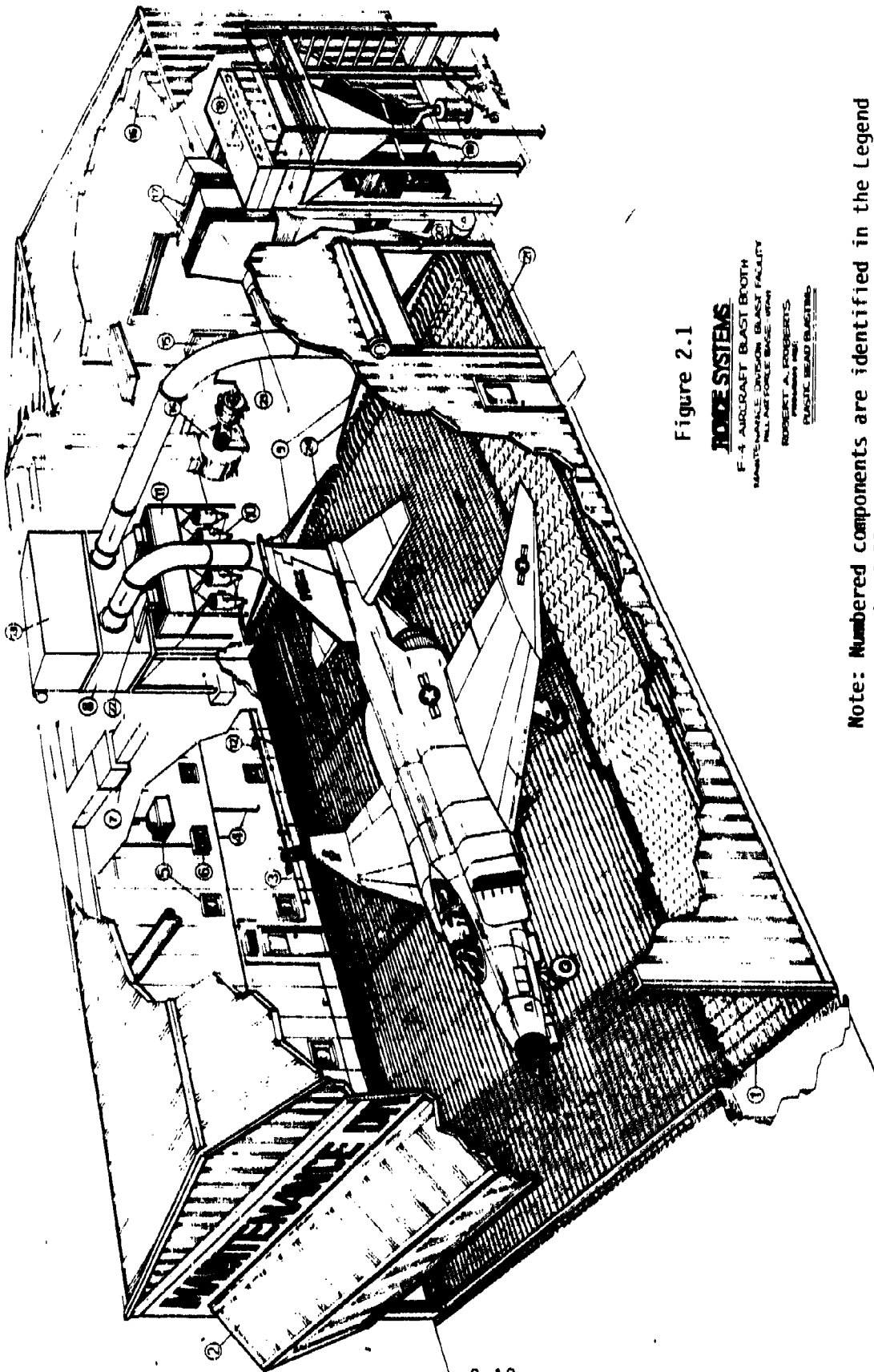


Figure 2.1


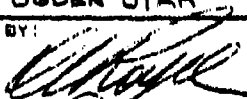
ROYCE SYSTEMS

F-4 AIRCRAFT BLAST BOOTH
 MAINTENANCE DIVISION BLAST FACILITY
 ALL AIR FORCE BASES - 1974
 ROBERT A. ROBERTS
 INVENTOR
 PLASTIC BEAD BLASTING

Note: Numbered components are identified in the Legend on the following page.

Source: Royce Mechanical Systems, August, 1984.

LEGEND	
NO.	DESCRIPTION
1	ROYCE - SUPPORT & PNEUMATIC FLOOR RECOVERY SYS.
2	BI-FOLD AUTOMATIC DOOR
3	CENTRAL VACUUM SYSTEM
4	UTILITY AIR
5	WALL AND CEILING LIGHTING
6	EMERGENCY LIGHTING
7	DOWN DRAFT VENTILATION REGISTERS
8	MEDIA RECOVERY CLASSIFIER
9	MEDIA RECOVERY MANIFOLD
10	BLAST GENERATORS
11	MEDIA STORAGE HOPPER
12	BLAST HOSE AND LIGHTED NOZZLE
13	RECOVERY SYS. CARTRIDGE DUST COLLECTOR
14	FAN UNIT - FLOOR RECOVERY SYSTEM
15	ELECTRICAL CONTROL PANEL
16	FRESH AIR SUPPLY INLET
17	HEATING COIL AND FAN-VENTILATION AIR
18	VENTILATION AIR DUST COLLECTOR
19	AIR COMPRESSOR & REFRIGERATED DRIER
20	HALON FIRE SUPPRESSION SYSTEM
21	SMALL PARTS BLASTING AREA
22	ROTARY FEED VALVES
23	MAIN RECOVERY PIPES
24	MEDIA RECOVERY FLEX CONNECTORS

 ROYCE MECHANICAL SYSTEMS INC. OGDEN UTAH		
SCALE: NONE	APPROVED BY: 	DRAWN BY: D. PETERSEN
DATE: AUG-84		REVISED:
GENERAL ARRANGEMENT AIRCRAFT PAINT REMOVAL BLAST BOOTH		
PRAM PROJECT NO. 00-143 AFLC 22983-01 USAF CONTRACT NO. F42650-84-C-3527		DRAWING NUMBER 1 OF 40

7. Safety Equipment

- Emergency lighting
- Halon fire suppression system
- Fire extinguishers
- Grounding wires
- Aircraft supports
- Scaffolding
- Personal protection equipment

Personal safety equipment includes the following, as discussed in Section 6.0:

During blasting

- Breathing airline hoods
- Coveralls
- Leather gloves
- Safety shoes
- Ear Protection

During cleaning of beads and dust

- Dust respirators
- Coveralls
- Goggles

Major components of the F-4 blast booth are discussed below.

Blasting Booth

The blast booth has four doors. The main access door, spanning the entire width of the booth, is located on the west end. The door is a standard horizontal hinged split overhead hanger type door. The south side of the booth has a standard overhead roll type door for equipment access and a standard personnel access door. A similar personnel access door is located on the north side of the booth. Each of these doors is connected to a

warning device consisting of a red strobe light mounted at the ceiling which is activated in the event that someone enters the booth during blasting. Opening any one of these doors can automatically shut down the blast air supply to the nozzles.

Fire protection in the blast booth is provided by a halogen gas suppression system mounted at the ceiling. This system is used because the blasting and bead reclamation system requires dry conditions, preventing the use of a water sprinkler fire suppression system.

Lighting in the booth is supplied by twelve lights, recessed in the booth walls, as well as overhead lighting to eliminate most shadows.

The blast booth includes a suspended ceiling and finished internal walls to minimize dust buildup. Due to the downdraft nature of the dust suppression and bead reclamation system (live floor and overhead return air), very little dust will be in suspension in the air. Because the dust is of an inorganic material, air flow and dust level monitors should not be required in this facility, and have not been included. Should OSHA rule they are required, they can easily be added.

The blast booth has a live floor. The floor is made of removable grates overlying a series of troughs. Fine wire mesh covers the troughs to catch oversized debris and prevent plugging of the holes at the bottom of the troughs. The troughs, or plenums, are connected to vacuum equipment, dust collection, and bead recovery systems.

The live floor system covers the entire floor area of the blast booth, wall to wall. The floor's air duct system is designed to provide equal suction over the entire floor area. This allows blasting areas to be used simultaneously throughout the booth, under normal blasting pressures, without loss of suction force in any particular area. This system prevents "dead" areas, a feature not found in other live floor air systems.

Dust separation and collection equipment is located outside the building and consists of screening equipment mounted on top of a dust collector. Reclaimed plastic beads are returned to bead storage hoppers in the building by steeply inclined chutes through the wall of the building. Dust is discharged from the bottom of the dust collector into sealed drums outside the building.

Equipment Room

The equipment room occupies about one-fifth of the building and is located at the east end. It is completely isolated from the blasting area and does not include access doors to the blasting area. This has been done to keep dust out of the equipment room and inadvertent access to the blast area by untrained personnel who may be working in the equipment room. A control/observation room has been built into the wall dividing the blasting area and the equipment room with the access door inside the equipment room. The observation room allows supervisors and visitors to watch the blasting procedure without having to enter the blasting area.

Two major pieces of equipment are used in the blasting booth: the blasting system and the work platforms. These were especially designed for the Hill Air Force Base stripping facility, but existing equipment may be modified for use with plastic media. The equipment and modifications are described below.

Blasting System

The blasting system consists of five 10 cubic foot vessels each with its own set of controls and gauges which can be preset and locked. Each vessel is connected to a pipe running along the north or south wall of the blast booth. There are five separate and independent blasting hoses, each having a half-inch nozzle strategically placed to cover the entire blasting area. The plastic bead storage hoppers are located inside the equipment room and are mounted above the blasting system machines.

A single 100 hp air compressor supplies blast air to all five blasting machines and produces a maximum blasting pressure of 40 psi to each nozzle. The air is filtered and dried. The weight of each of the blasting hoses is carried by overhead counter-weighted mechanisms. This reduces operator fatigue, and prevents the hoses from dragging on the deck or fouling the equipment being blasted.

Work Platforms

Specially designed, wheeled work platforms have been built to provide access to all surfaces being treated. The wheels are sized to operate over the floor grating and include locking mechanisms. These platforms are made of industrial grade floor grating and have handrails. Parts of the platforms have been covered with rubber cushions to prevent damage to aircraft surfaces.

Modifications to Existing Equipment

A live floor can be easily installed on top of an existing concrete hanger floor. The live floor structure is only 6 inches deep. Mounting on an existing floor would require shallow ramps from the existing floor level to the top of the live floor grating.

If an existing Glove Booth is to be modified for use with plastic material, the booth should be thoroughly cleaned of all existing blasting materials. An adequate dust collector must be connected to the booth so that the hazardous waste can be collected for disposal. Light-weight leather gloves placed over standard glove booth rubber gloves will increase service life. It is critical that air withdrawn by the recycling system in the glove booth be balanced with air flow from the nozzle to ensure proper operation and to minimize dust leakage from the booth.

Existing sand blasting equipment can be used for plastic blasting with the following modifications (Tech Order 1F-4C-3-1-6, Roberts, February 1985):

1. Install a standard pressure control valve in the inlet air supply line at the inlet air line connection point. The valve size will match the inlet air line size for pipe diameter. This control valve is necessary to provide a nozzle pressure of 40 psi or less.

2. Install a standard one-way air flow check valve between the air regulator and the inlet to the blast pot. The check valve will be the same diameter as the inlet air supply line. This check valve is required to prevent material back-flow into the pressure regulator during operation.

3. If the existing pressure pot has a round bottom, install a standard air operated vibrator on the lower side of the pot. This is required to ensure a constant flow of plastic into the blast hose. NOTE: If the pressure pot has a 60 degree cone, the vibrator is not necessary.

4. Install a light-weight blast hose - preferably with nylon nozzle connections. Ensure that the hose is designed for blasting and has an integral ground. A standard weight sand blast hose is not necessary for use with the plastic media. Standard bronze hose fittings are not necessary for use with blast media.

5. Install a permanent magnet in the return plastic media flow path. This will trap any small steel shavings which are removed from damaged screw heads. Removal at this point will prevent contamination of the recycled plastic blasting material with steel particles. These steel particles, if allowed to remain in the plastic material, will cause damage to the aluminum surfaces during future blasting operations.

Capital Costs

The construction contractor's original bid for the plastic media paint stripping facility at Hill Air Force Base was as follows:

STRUCTURE	<u>Costs (1984 \$)</u>	
Prefabricated Building	78,000	
Electric Transformer	<u>28,000</u>	
Subtotal		106,000
EQUIPMENT		
Blasting Machinery	12,500	
Live Recovery Floor	300,000	
Air Handler and Classifier	120,000	
Fire Extinguishing System	<u>41,000</u>	
Subtotal		<u>473,500</u>
Total		\$679,500

These costs include materials, equipment, and labor. The live floor represents almost 50% of the capital investment. The price of the floor probably reflects some development costs and therefore may be smaller for subsequent installations. Since this was a prototype facility in which many innovations were made as construction progressed, the overall cost is apparently around \$1,000,000. Future modular design packages for similar facilities have been proposed. Costs could be about \$750,000 per module and vary depending on number of modules and unique mission requirements and site conditions.

Operation and Maintenance Costs

Operation and maintenance costs for this facility will include labor, materials, energy, waste disposal, and maintenance. Preliminary data for the F-4 facility includes the following:

	<u>Time</u>		<u>Rate</u>		<u>Total</u>
Labor	48 hrs/aircraft	@	\$35.56/hr	=	\$1612/aircraft
Materials (Beads)	200 lbs/aircraft	@	\$1.73/lb	=	\$346/aircraft
Energy Use					
Waste Disposal					
Maintenance					

(Refer to the presentation by Bob Roberts
on the following pages and to AFLC Form 177
in Section 5)

Labor comprises a large portion of the operating cost. As the operators become more proficient at their tasks, the manhours required to strip an aircraft may decrease. All of these cost estimates are based on early 1985 costs at Hill Air Force Base.

Presented by Bob Roberts, Project Developer

PURPOSE

TO PROVIDE SPECIFIC INFORMATION RELATING TO PRAM PROJECT 00-143
AT HILL AIR FORCE BASE, UTAH

AREAS IDENTIFIED:

- BACKGROUND
- OBJECTIVES
- PROJECT TASKS
- IMPLEMENTATION
- SCHEDULES
- FACTORS
- ECONOMICS - I & II
- ENVIRONMENTAL ASSESSMENTS
- SUMMARY

OBJECTIVES

- TEST EVERY KNOWN SUBSTRATE FOR EFFECTS OF BLASTING
- ESTABLISH NOZZLE PRESSURE LEVELS AND PLASTIC MEDIA SIZE
- DEVELOP TECHNIQUES FOR PAINT REMOVAL FROM LARGE/INTRICATE SURFACES
- ELIMINATE CONTAMINATION HAZARDS ASSOCIATED WITH CHEMICALS
- MEET THE OSHA/EPA REQUIREMENTS
- IMPROVE WORKING CONDITIONS
- DECREASE TIME
- IDENTIFY PROBLEMS ASSOCIATED WITH BLASTING

BACKGROUND

- * CHEMICALS ARE THE PRESENT "STATE-OF-THE-ART" FOR PAINT REMOVAL
- * CHEMICALS ARE EXPENSIVE (\$585,000 EXPENDED AT HILL AFB IN FY 83)
- * BIO-ENVIRONMENTAL PROBLEMS AND SAFETY HAZARDS
- * CHEMICALS DO NOT REMOVE ALL PAINT - HAND SANDING REQUIRED
- * SEWER CONTAMINATION ABOVE EPA ALLOWABLE LIMITS
- * EPA DEMANDS CONTINUAL IMPROVEMENT
- * CHEMICAL PAINT REMOVAL IS TIME CONSUMING
- * CHEMICALS NEED HEAT TO WORK - HEAT MEANS ENERGY CONSUMPTION
- * CHEMICALS DESTROY CONCRETE FLOORS
- * LARGE AMOUNTS OF WATER ARE REQUIRED FOR RINSING - ALL CONTAMINATED
- * CHEMICALS ARE WORK INTENSIVE

PROJECT TASKS

- * OBTAIN AUTHORITY UNDER "PRAM" TO VERIFY PROCESS
- * BUILD A FACILITY WITH "PRAM" MONEY
- * PROVIDE A STATEMENT OF WORK FOR PROCUREMENT ACTION
- * IDENTIFY THE ITEM AS "EQUIPMENT" NOT A MILITARY CONSTRUCTION PROGRAM
- * PREPARE DOCUMENTS FOR PROCESSES/PROCEDURES - TECH DATA
- * DEFINE THE TASKS TO BE ESTABLISHED
- * PROVIDE MILESTONES
- * ESTABLISH A CONTROL/REPORTING SYSTEM

IMPLEMENTATION

- PROVIDE ARMY/NAVY/AIR FORCE ACTIVITIES WITH SPECIFICS
- PERFORM CONCURRENT TESTS WITH ALL AGENCIES
- COMPLETE TEST PHASES AND VERIFY PROCEDURES
- VALIDATE TECH DATA
- OBTAIN AUTHORIZATION IN APPLICABLE TECH ORDERS
- TESTS - TESTS - AND MORE TESTS
- RESPOND TO "DEVIL'S ADVOCATE"
- MEET MILESTONES FOR DEVELOPMENT

SCHEDULE

- OBTAIN PRAM AUTHORIZATION
- TRANSFER FUNDS FROM ASD TO AFLC
- STATEMENT OF WORK TO PROCUREMENT
- AWARD CONTRACT
- START CONSTRUCTION
- MAINTAIN SURVEILLANCE
- CONCURRENT TESTING
- ON-GOING DEMONSTRATIONS
- BLAST A COMPLETE F4 AIRCRAFT
- PROVIDE REPORTS

FACTORS

- * TESTS ON F4 COMPONENTS VERIFIED BY METALLURGICAL LAB AS SAFE
- * TECH ORDER 1-1-8 AND 1F-4C-3-1-6 ALLOWS BLASTING
- * TESTS INDICATE REMOVAL RATES OF 1.5 TO 2.5 SQ FT PER MINUTE
- * PLASTIC MEDIA AVAILABLE THROUGH GSA
- * BLAST EQUIPMENT AVAILABLE FROM AT LEAST 3 DIFFERENT MANUFACTURERS
- * REFURBISHMENT OF EXISTING FACILITIES A REALITY
- * CONTINUATION OF TESTING PROGRAM - HONEYCOMB - COMPOSITES - ETC.
- * AMORTIZE RATES ARE PHENOMINAL
- * ALMOST TOTAL ELIMINATION OF CHEMICAL HAZARDS
- * SAVINGS IN : MANPOWER - MATERIALS - ENERGY

S A V I N G S

C O S T C O M P A R I S O N

CHEMICAL VRS PLASTIC BLAST

	CHEMICAL	PLASTIC
HEATING/STEAM	\$ 938.00	\$ 0.00
ELECTRICAL	231.00	127.00
INDUSTRIAL WASTE	2,462.00	0.00
MATERIALS	5,335.00	346.00
LABOR	11,546.00	1,321.00
FLOW DAYS	7,343.00	1,049.00
TOTALS	\$27,855.00	\$2,843.00

SAVINGS PER AIRCRAFT: $(\$27,855.00) - (\$2,843.00) = \$25,012.00$

ANNUAL SAVINGS: $(215 \text{ AIRCRAFT}) \times (\$25,012.00) = \$5,377,580.00$

ECONOMICS - II

PRODUCTION COMPARISONS

END ITEM	CHEMICAL TIME	BLASTING TIME
RUDDER	3 HR 36 MIN	15.6 MIN
INBD L/E FLAP	2 HR 48 MIN	21.6 MIN
SPOILER	40 MIN	14.4 MIN
OUTBD L/E FLAP	2 HR 48 MIN	18.6 MIN
AILERON	6 HR 28 MIN	32.4 MIN
WINGFOLD	8 HR 45 MIN	54.1 MIN
STABILATOR	9 HR 49 MIN	55.2 MIN
COMPLETE F4 (PROTOTYPE)	341 HR	39 HR
P-8 PUMPER FIRE TRUCK	52 HR	4 HR
D-50 PICKUP	40 HR (SANDING)	1 HR 20 MIN
1/2 TON DODGE RAM PICKUP	60 HR (SANDING)	1 HR 55 MIN

ENVIRONMENTAL ASSETS

- DUST COLLECTORS MAKE IT POSSIBLE TO RECYCLE BLASTING MATERIAL
- 50 FPM AIR WILL ELIMINATE DUST PROBLEMS
- NO WATER POLLUTION
- VERY LITTLE WASTE HAZARD

BURN POWDER AS FUEL

PLATE OUT CHROME

- OSHA/EPA REQUIREMENTS CAN BE ACHIEVED
- VERY LITTLE PEOPLE PROBLEMS

SUMMARY

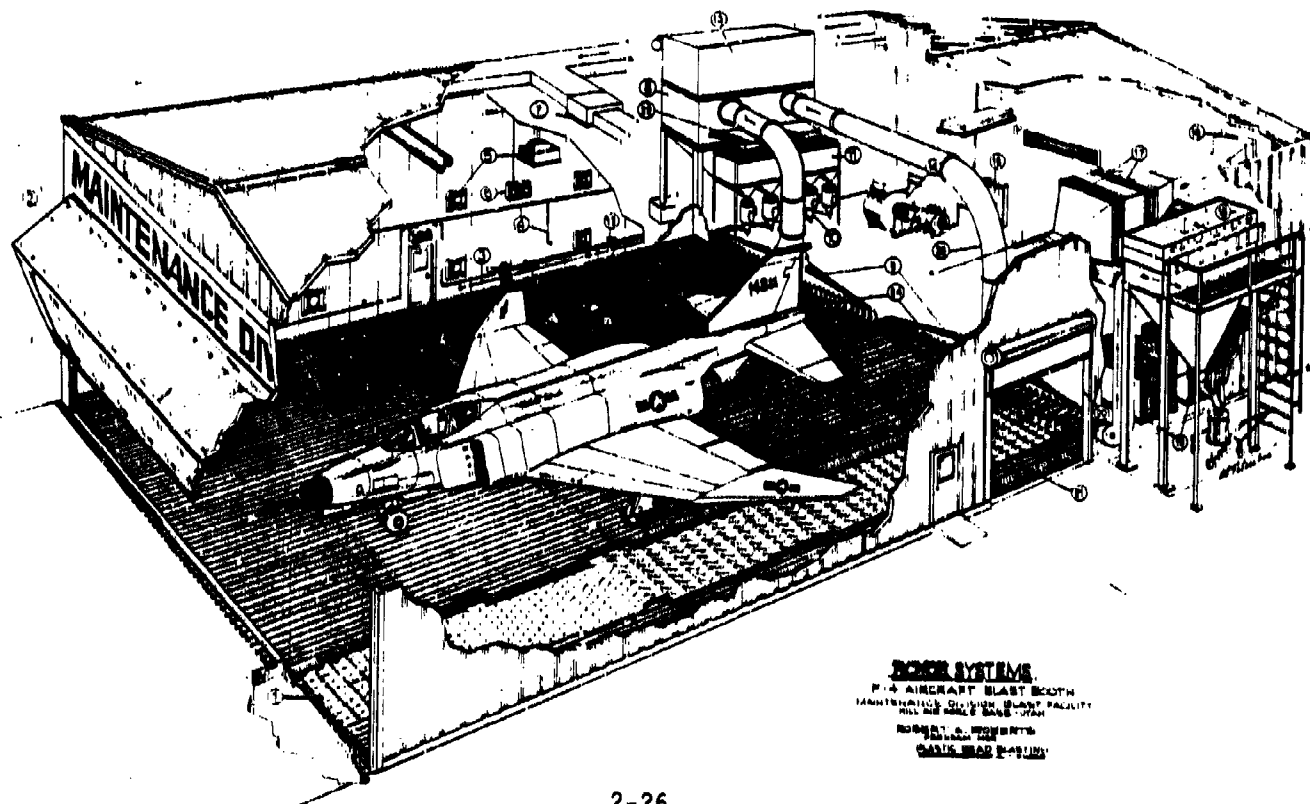
- OSHA/EPA DEMANDS THE REMOVAL OF CHEMICALS
- PLASTIC BLASTING IS AVAILABLE NOW - NO DEVELOPMENT
- GOVERNMENT APPROVAL EXPECTED IMMEDIATELY
- MONEY SAVED CAN BE USED FOR FOLLOW-ON DEVELOPMENT IN:

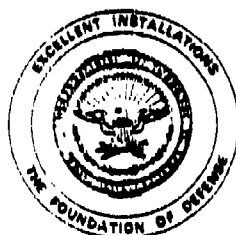
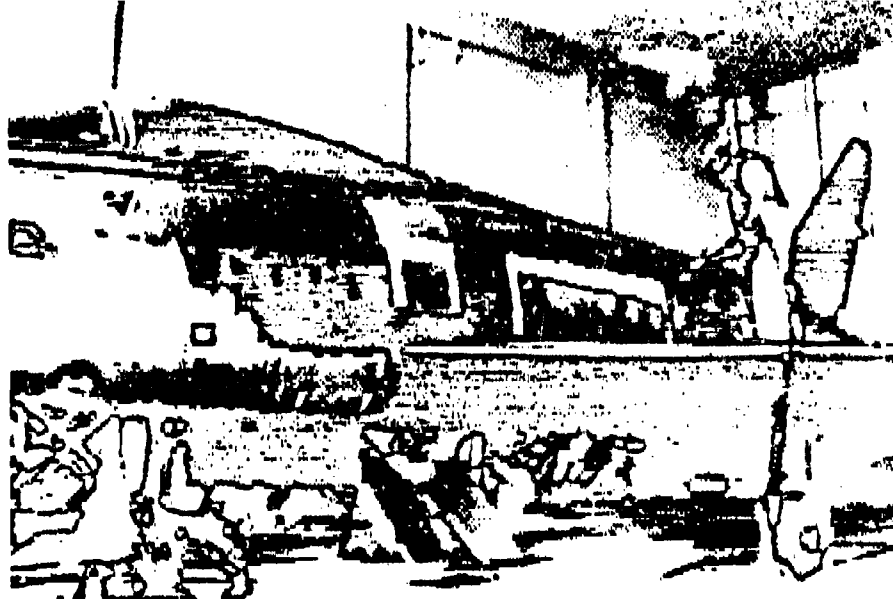
LAZER

FLASH LAMP

ROBOTIC APPLICATIONS

- EQUIPMENT/MATERIALS AVAILABLE
- MONETARY SAVINGS ARE REAL





1984 ANNUAL ENVIRONMENTAL PROTECTION SUMMARY

of the

Assistant Secretary of Defense MANPOWER, INSTALLATIONS AND LOGISTICS

ABOUT THE COVER

REMOVING PAINT FROM AIRCRAFT HAS BEEN A COSTLY AND MESSY JOB SINCE THE BEGINNING OF AVIATION. WORSE, USING OUR OLD METHODS WE PRODUCED ABOUT 20,000 GALLONS OF HAZARDOUS WASTE WHEN STRIPPING AN AIRPLANE.

THE COVER PHOTO SHOWS AN AIRMAN AT HILL AIR FORCE BASE REMOVING PAINT USING A NEW PLASTIC BEAD BLASTING PROCESS THAT PRODUCES ONLY 100 POUNDS OF DRY WASTES. WHEN THE NEW SYSTEM IS PUT IN PLACE THROUGHOUT THE DEPARTMENT, IT WILL AVOID GENERATION OF MILLIONS OF GALLONS OF HAZARDOUS WASTE AND SAVE OVER \$100,000,000 ANNUALLY IN OPERATING AND WASTE DISPOSAL COSTS.

THE NEW PROCESS WAS DEVELOPED BY THE HILL AIR FORCE BASE WORK FORCE. IT'S A PRIME EXAMPLE OF HOW WE ARE WORKING TO SAVE MONEY AND REDUCE HAZARDOUS WASTE GENERATION.

EXCERPTED FROM PAGE 3 OF THE GENERAL REPORT:

"REDUCING THE AMOUNT OF WASTE WE GENERATE IS ESPECIALLY WORTHWHILE. ONE INNOVATION WE ARE PARTICULARLY PROUD OF IS A SYSTEM PERFECTED BY 'WORKERS AT HILL AIR FORCE BASE' THAT REDUCES WASTE FROM AIRPLANE PAINT STRIPPING BY 99%. IMPLEMENTING THIS SYSTEM ACROSS THE DEPARTMENT WILL ELIMINATE THOUSANDS OF TONS OF HAZARDOUS WASTE AND SAVE OVER \$100 MILLION ANNUALLY."

FORMULATION FOR COST SAVINGS

HEATING/STEAM

BUILDING 223 - PLASTIC BLASTING

* HEAT RECOVERY AVAILABLE FROM AIR COMPRESSOR & DRYER = 500,000 BTU/HR

$$(.90 \frac{\text{BTU/HR}}{\text{CFM F}}) \times (1,375 \text{ CFM}) \times (60 \text{ F} - 6 \text{ F}) = 66,825 \text{ BTU/HR}$$

* HEAT LOAD BUILDING 223

$$\frac{(20 \text{ FT/HR}) \times (300 \text{ FT PERIMETER}) \times (60 \text{ F} - 6 \text{ F})}{7 \frac{\text{FT F}}{\text{HR}} \text{ BTU}} = 46,285 \text{ BTU/HR WALLS}$$

$$\frac{(50 \text{ FT}) \times (100 \text{ FT}) \times (60 \text{ F} - 6 \text{ F})}{19 \frac{\text{FT F}}{\text{HR}} \text{ BTU}} = 14,210 \text{ BTU/HR ROOF}$$

TOTAL LOAD = 127,320 BTU/HR

* (500,000 BTU/HR) - (127,320 BTU/HR) =

NO HEAT REQUIRED

FORMULATION FOR COST SAVINGS

HEATING/STEAM

BUILDING 220 - CHEMICAL STRIPPING

* CUBIC FEET PER MINUTE FRESH AIR

$$(130 \text{ FT/LG}) \times (39 \text{ FT/HR}) \times (100 \text{ FT/MIN/FLO}) = 507,000 \text{ CFM}$$

* AVERAGE YEAR/ROUND AIR TEMPERATURE = 51 DEGREES F

* COST OF STEAM FOR HEAT = \$5.59 PER MILLION BTU'S

ANNUAL COST:

$$(.90 \frac{\text{BTU/HR}}{\text{CFM F}}) \times (507,000 \text{ CFM}) \times (70 \text{ F} - 51 \text{ F}) \times \left(\frac{16 \text{ HRS}}{\text{DAY}} \right) \times \left(\frac{260 \text{ DAYS}}{\text{YEAR}} \right) \times \left(\frac{\$5.59}{1 \text{ MIL BTU}} \right) = \$201,600.00$$

* COST PER AIRCRAFT

$$\frac{\$201,600 \text{ STEAM}}{215 \text{ AIRCRAFT}} = \$938.00 ***$$

FORMULATION FOR COST SAVINGS
ELECTRICAL
COST PER KILOWATT HOUR = \$0.05

* BUILDING 220 - CHEMICAL STRIPPING
EQUIPMENT:

(8 SUPPLY FANS) X (25 HP EACH) = 200 HP
(16 EXHAUST FANS) X (7½ HP EACH) = 120 HP
320 HP

* ANNUAL COST:

(.7457 $\frac{\text{KW}}{\text{HP}}$) X (320 HP) X (16 HR/DAY) X (260 DAYS/YEAR) X \$0.05/KWH = \$49,634.00

* COST PER AIRCRAFT: $\frac{\$49,634.00}{215 \text{ AIRCRAFT}}$ = \$231 ***

* BUILDING 223 - PLASTIC BLASTING
EQUIPMENT:

PRIMARY AIR 150 HP
SECONDARY AIR 25 HP
AIR COMPRESSOR 150 HP
REFRIG DRYER 15 HP
340 HP

* COST PER AIRCRAFT:

(.7457 $\frac{\text{KW}}{\text{HP}}$) X (340 HP) X (10 $\frac{\text{HRS}}{\text{ACFT}}$) X (\$0.05/KWH) = \$127.00 ***

FORMULATION FOR COST SAVINGS
INDUSTRIAL WASTE

* BUILDING 220 - CHEMICAL STRIPPING EFFLUENT = 210,000 GAL/DAY

* TOTAL INDUSTRIAL WASTE PLANT EFFLUENT = 600,000 GAL/DAY

* ALLUAL COST OF CHEMICALS TO OPERATE INDUSTRIAL WASTE PLANT = \$912,500.00

* ANNUAL COST OF SLUDGE DISPERSAL/TRANSPORTATION = \$600,000.00

* TOTAL YEARLY PLANT COSTS \$1,512,500.00

* CHEMICAL STRIPPING SHARE OF COSTS:

$\frac{210,000 \text{ GAL/PER/DAY}}{600,000 \text{ GAL/PER/DAY}} \times 100 = 35\%$

* COST PER AIRCRAFT: $(35\%) \times \frac{(\$1,512,500.00)}{215 \text{ AIRCRAFT}} = \$2,462.00$ ***

* BUILDING 223 - PLASTIC BLASTING

* NO INDUSTRIAL WASTE EFFLUENT

FORMULATION FOR COST SAVINGS

M A T E R I A L

* BUILDING 220 - CHEMICAL STRIPPING

CONSUMPTION = 468 GALLONS PER AIRCRAFT

COST PER GALLON = \$11.40

COST PER AIRCRAFT:

$$(468 \text{ GAL}) \times (\$11.40) = \$5,335.00 \text{ ***}$$

* BUILDING 223 - PLASTIC BLASTING

CONSUMPTION = 200 POUNDS PER AIRCRAFT

COST PER POUND = \$1.73

COST PER AIRCRAFT:

$$(200 \text{ POUNDS}) \times (\$1.73) = \$346.00 \text{ ***}$$

FORMULATION FOR COST SAVINGS

L A B O R

FY 85 RCC APPROVED RATE \$33.86 PER HOUR

* BUILDING 220 - CHEMICAL STRIPPING

ENGINEERING STANDARD FOR F-4	296 HOURS
------------------------------	-----------

ENGINEERING STANDARD FOR COMPONENTS	45 HOURS
-------------------------------------	----------

TOTAL	341 HOURS
-------	-----------

* COST PER AIRCRAFT: (341) X (\$33.86) = \$11,546.00 ***

* BUILDING 223 - PLASTIC STRIPPING

F-4 BLAST STRIPPING "TEST" RESULTS	39 HOURS
------------------------------------	----------

* COST PER AIRCRAFT: (39 HRS) X (\$33.86) = \$1,321.00 ***

FORMULATION FOR COST SAVINGS

A I R C R A F T F L O W D A Y S

(DERIVED FROM USAF COST & PLANNING FACTORS - AFR 173-3)

F-4 UTILIZATION RATE = 0.68 HRS/DAY

F-4 LIFE CYCLE COST = \$3,086 PER FLYING HR

COST PER FLOW DAY = 0.68 HRS/DAY X \$3,086 PER/HR = \$2,098 PER FLOW DAY

CHEMICAL STRIPPING:

3.5 X \$2,098 = \$7343 PER ACFT *** \$7343 X 215 ACFT = \$1,578,745 YEAR

PLASTIC BLASTING:

.5 X \$2,098 = \$1049 PER ACFT *** \$1049 X 215 ACFT = \$ 225,535 YEAR

ANNAUL SAVINGS = (\$1,578,745) - (\$225,535) = \$1,353,210

3.0 ALTERNATIVE PROCESS MODIFICATIONS

3.1 Wet Chemical Paint Stripping - Solvent Recovery and Reuse

- Activated Carbon
- Centrifugation, Filtration, Ultrafiltration, and Reverse Osmosis
- Distillation
- Solvent Technology Recommendations

3.2 Advanced Paint Stripping Alternatives

- Lasers
- Flash Lamps
- Water Jets
- CO₂ Pellets
- Cryogenics
- Salt-Baths
- Burn-Off Systems
- Hot Caustics

Presentation by Tom Higgins, Project Manager, CH2M HILL

3.0 Alternative Process Modifications

3.1 Wet Chemical Paint Stripping

Major reductions in the amount of waste solvent generated by wet chemical stripping processes can be achieved by reusing the solvents. Solvent reuse prolongs the life of paint stripping solvents and minimizes the use, and waste, of fresh solvents. Though not implemented, estimates at Ogden Air Force Base indicate over \$60,000/month could be saved if a solvent reuse program was used (Walker, Maj. T.J., et al, 1984).

Solvent Recovery and Reuse

Many technologies are available for reusing and recovering solvents. These processes separate solvents from contaminants, i.e., paint. The most promising technology, which can be applied to almost all DOD facilities, is distillation. Solvent recovery using distillation can be done in four ways: on-base recycling, off-base contract recycling, sale to off-base recyclers, and manufacturer take-back. Other commercially available recovery technologies which may be applicable to a particular process are centrifugation, filtration, ultra-filtration, reverse osmosis, and activated carbon. These recovery technologies are described below.

Activated Carbon

Activated carbon is used to capture solvent vapors. The vapors are adsorbed onto the surface of the carbon, then steam is used to strip the adsorbed solvents off the carbon. The solvent can then be recovered from the steam condensate.

Centrifugation, Filtration, Ultrafiltration, and Reverse Osmosis

These technologies are appropriate for emulsion-type solvents used in machining processes but are not usually used for recycling cleaning solvents. Centrifugation and filtration are used to remove metal chips and other contaminants from machining process allowing the machine solvent to be reused. Most modern machining equipment can be supplied with built-in solvent recycling systems.

Ultrafiltration and reverse osmosis are used primarily to separate water from the emulsified oil streams. These processes are very waste stream specific and are not commonly used.

Distillation

Distillation relies on heating a solvent enough to vaporize it and then condensing the vapor. The condensed vapor, or solvent, is reused. The contaminant, which does not vaporize, is discarded. If the boiling point of the solvent is high (over 200°F), the distillation is usually done under a vacuum to minimize thermal decomposition of the solvent. Another technique used for high boiling point solvents is to inject steam into the solvent and form an azeotropic mixture that has a lower boiling point. The water and solvent condensate is then separated by gravity. There is usually a 10:1 to 15:1 volume reduction of waste to be disposed of when recycle by distillation is used compared to stripping operations that do not recover solvents.

Distillation systems that can distill solvent quantities ranging from 0.5 to 100 gallons per hour are commercially available. The smaller systems are self-contained, off-the-shelf units that can be installed in any sheltered area with electrical power and cooling water available. The larger units are generally more complex and require steam. The capital cost is generally about \$5,000 plus \$1,000-per-gallon-per-hour capacity. For example, a 50-

gallon-per-hour still will cost about \$55,000. Generally the payback period for a still purchase is between 6 months and 2 years. The normal life-time of a still is about 20 years. Table 1 lists the major suppliers of self-contained solvent distillation apparatus.

Table 1

SUPPLIERS OF SELF-CONTAINED DISTILLATION APPARATUS

Solvent Process Equipment Manufacturers

Detrex Chemical Industries, Inc., Detroit, Michigan
Baron-Blakeslee, Melrose Park, Illinois
Corbane Industries, Inc., Louisville, Kentucky
Vapor Engineering, Inc., Pensacola, Florida
Phillips Manufacturing Co., Chicago, Illinois
Gardner Machinery, Charlotte, North Carolina
Finish Engineering, Erie, Pennsylvania

The operating costs of a distillation apparatus include labor, energy, cooling water, and maintenance parts. Normally, the biggest expense is labor.- These stills require a moderately trained operator to attend them about 10 percent of the time they are in operation.

In order for recycling to be effective, solvents should be segregated. If two or more solvents are mixed, the still will probably not be able to separate them. Solvent segregation is probably the major obstacle to implementation of solvent recycling.

An alternative to purchasing a still is to use an off-base recycler to distill solvents. This can be done in two ways. The first way is to contract with the off-base recycler to distill and return spent solvents. The second way is to sell the solvents to the recycler. The best method

depends on the availability of a local recycler, the type of solvent recycled and the economics of on-base versus off-base recycling. Normally, it is preferable to use an on-base still because of cost, control, and convenience reasons.

Manufacturers will take back some solvents for reprocessing for free or for a nominal fee paid by either the manufacturer or the user. This is usually an attractive way of disposing of used solvents.

Solvent Technology Recommendations

The most promising process for recycling cleaning solvents is on-base distillation. It has proven to be a net cost saver and easy to implement and operate at several locations. It does require careful solvent segregation. Also, some recycled solvent may not meet original specifications and may have to be reused in less sensitive processes. There may be instances where off-base recycling or manufacturer take-back may be a better solution. These have to be evaluated on a case-by-case basis.

One of the key elements to successful solvent recycling is management support. Successful recycling requires extensive coordination and cooperation with solvent purchasers, solvent users, and the solvent reprocessors. Traditional disposal procedures, such as disposing of all solvents in a single container, have to be modified to maintain solvent segregation. Solvent cleaning procedures may have to change as well because recycled solvents may not meet the specifications of the original solvent.

3.2 Advanced Paint Stripping Alternatives

New paint stripping technologies continue to be developed by industry and the military for special applications, increased productivity, lower costs, and reduced waste generation. These advanced technologies are in the R&D

development stage or used only for special applications and have not been applied commercially. They may be feasible alternatives in the future; therefore a brief description of each process is provided.

Laser Paint Stripping

Laser paint stripping has been tested using a pulse CO₂ laser. An infrared frequency laser beam was used to vaporize (presumably to CO₂ and H₂O) paint from a test surface, leaving virtually no material residue. Hazardous waste generation was eliminated. The laser was not effective in removing pore deposits, and there is a potential problem with damage to aircraft electronics. There is also concern about flammability with laser stripping. Though inexpensive to operate, the laser is expensive to purchase, requires robotic control to obtain the necessary precision and is extremely complicated to operate and maintain, requiring highly skilled operators. Though promising, this technique for hazardous waste reduction is still in the testing stages. It has not yet been implemented in place of conventional solvent stripping at any DOD site.

Flash Lamp Stripping

Flash lamp stripping is similar to laser stripping, but uses high energy quartz lamps to vaporize paint. Unlike laser stripping, flash lamps will not harm aircraft electronics. However, this technique is difficult, requiring extensive operator training. In Navy tests, this method failed to remove barnacles from the bottom of ships, and produced loud, annoying "bangs" when operating. In spite of these problems, the method is being tested because of its potential for tremendous reduction of hazardous waste generation. Mr. Mike Halliwell, Wright Patterson Air Force Base, believes that flash lamp and laser stripping have equal probabilities for success.

Water Jet Stripping

Water jet stripping uses water under high pressure to remove paint. This method was tried but discontinued because it caused damage to some aircraft surfaces. The method was used successfully for paint removal from a landing gear, but has not been permanently implemented.

CO₂ Pellet Stripping

CO₂ pellet stripping involves stripping by blasting with pellets of CO₂ dry ice. The high pressure required to strip paint from aircraft was greater than that allowed for aircraft skin surfaces (Roberts, R.A., 1984). An advantage of this process, warranting further research, is that the carbon dioxide vaporizes and does not contribute to hazardous waste generation.

Cryogenic Stripping

Cryogenic removal of paint by freezing in liquid nitrogen and physically "knocking" the paint off, has been tried but is not yet workable or cost effective. In addition, the process required total immersion in liquid nitrogen, which limits application to smaller parts (some work is being done in which liquid nitrogen is poured over entire aircraft). However, the effect of extremely cold temperatures on aircraft electronics, rivets, bolts, etc., is not yet known.

Salt-Bath Paint Stripping

Equipment is commercially available to strip paints in molten salt baths operating at a temperature of 900°F. This method is used in the automotive and appliance manufacturing industries. Items to be stripped (normally steel) are immersed in the molten salt bath (mixture of sodium hydroxide, sodium or potassium nitrate, sodium chloride, and catalysts). This process

is not compatible with most military applications because it cannot be used on the materials military equipment is constructed of - mainly aluminum, non-metallics, and alloys.

Burn-off Systems

High temperature flames, ovens, and fluidized beds are commercially used to literally burn the paint off - mostly from steel surfaces. This technology is not compatible with most military applications because its use is limited to steel parts.

Hot Caustic Strippers

Hot caustic solution stripping is used commercially, and equipment is readily available. Hot caustic baths, typically at temperatures over 200°F, are very effective in removing caustic sensitive paints. Many coatings used by the military, such as epoxies, are both caustic and heat resistive. This system is limited to paint removal from steel parts because the caustic corrodes many materials, including aluminum. This technology is not compatible with most military operations.

Presented by Tom Higgins, Project Manager, CH2M HILL

Alternatives

- Solvent Stripping & Waste Treatment
- Reduce Waste Volume
- Recover Solvent & Reuse
- Alternate Paint Removal Techniques

WASTE TREATMENT

PHENOLS

CARBON ADSORPTION
BIOLOGICAL OXIDATION

METHYLENE CHLORIDE

AIR STRIPPING
CHEMICAL OXIDATION

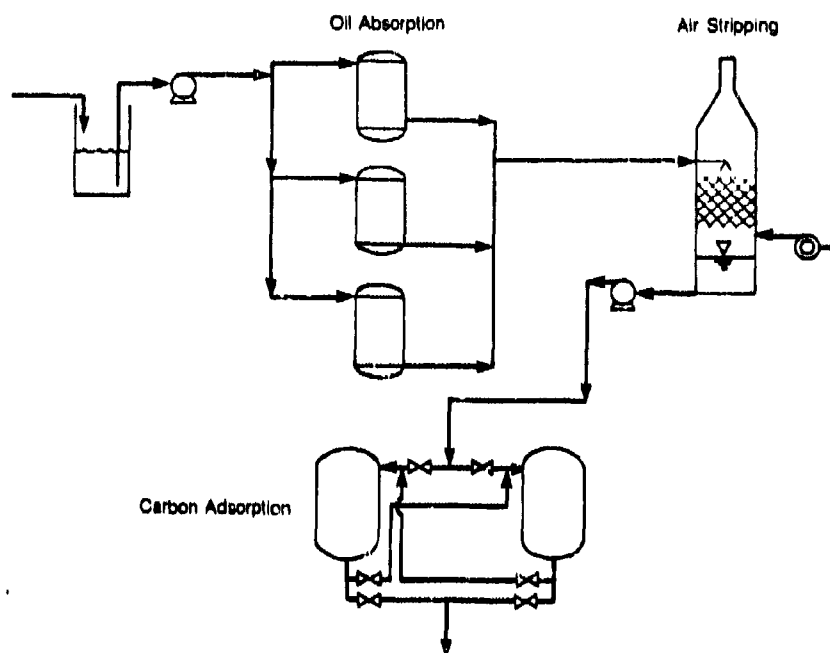
Reduce Waste Volume

- Paper on Floor (Norfolk)
- Troughs & Drums (Pan Am)
- Squeegee
- Use of Decals

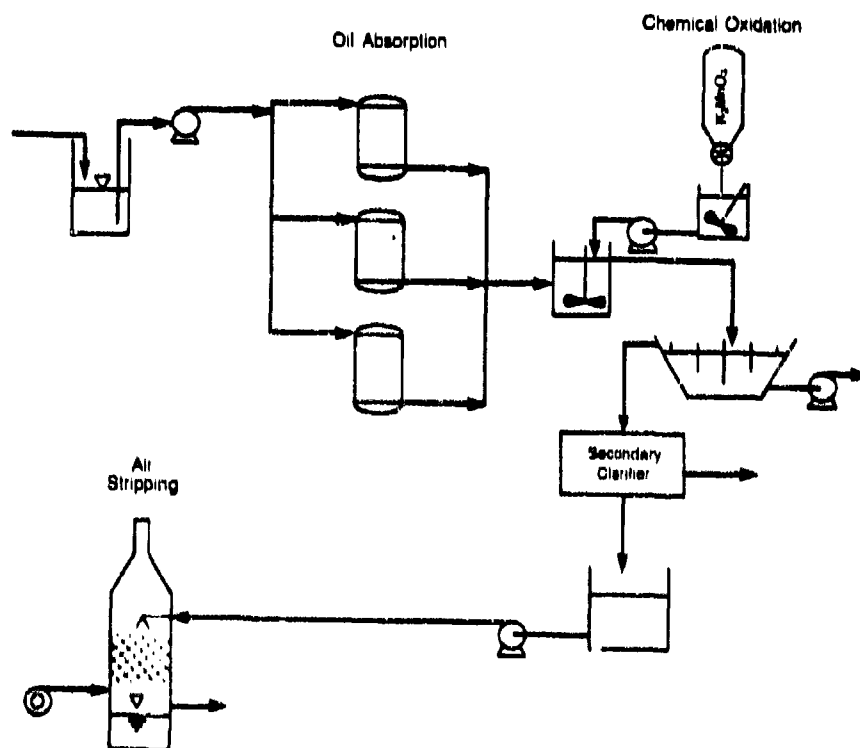
Limitations

- Waste More Concentrated
- Does Not Reduce Air Emissions
- Waste Water Still Produced
- Labor Intensive
- Decals Not for Military Aircraft

End of Pipe Carbon Adsorption Treatment Process



End of Pipe Chemical Oxidation Treatment Process



Recover Solvent & Reuse

- Filtration (HILL AFB)
- + Potential \$60,000/Month Saving
- Labor Intensive
- Loss of Effectiveness

Alternate Paint Removal Techniques

- Plastic Media Blasting
- Sand and Glass Bead Blasting
- Rice Hulls and Walnut Shells
- Dry Ice Blasting
- Pulsed CO₂ Laser
- Flash Lamp Stripping
- Cryogenic
- Water Jet Blasting
- Burn-Off Systems
- Hot Caustic Strippers

Plastic Media Blasting

- + Most Promising
- + Cost Effective
- + Operational
- + Commercial

Sand & Glass Bead Blasting

- + Dry Process
- Damages Aluminum & Delicate Parts
- Media Shatters Producing Dust
- Respiratory Problems

Rice Hulls & Walnut Shells

- + Dry Process
- + Suitable for Soft Metals
- Subject to Biological Growth
- Produce Dust
Respiratory Problems
Visibility
- Not Recycled
- Increased Haz Waste

Dry Ice Blasting

- + Dry Method
- + Media Volatilizes
- Costs
- Effectiveness Questionable

Pulsed CO₂ Laser Stripping

- + Dry Method
- + Effective
- Experimental
- Expensive (\$10 Million)
- Needs Robot Control
- Potential Damage to Substrates and Electronic Components

Flash Lamp Stripping

- + Dry Process
- + Not Harmful to Electronics
- Noisy
- Slow & Cumbersome
- Not a Sight Process
- Air Pollutants?

Cryogenic

- + Small Units Commercial
- Not for Large Areas

Water Jet Blasting

- + No Solvent
- Reliability
- Potential Substrate Damage
- Operator Safety?

Burn-Off Systems

- + Dry
- High Temperature Not Suitable for Aluminum

Hot Caustic Strippers

- Not Effective For Epoxies
- Corrosive to Aluminum, Zinc, etc.
- High Temperature

4.0 PROJECT REQUIREMENTS

Mechanical Paint Removal System: Special Report on Plastic Impact Cleaning Media, R.A. Roberts, 1984.

Interim Report on Stripping Paint from the First F-4E Prototype at Hill AFB on 31 July 1984, R.A. Roberts, 21 January 1985.

Interim Report on Stripping Paint from the Second F-4E Prototype at Hill AFB on 20 May 1985, R.A. Roberts, 20 May 1985.

Stripping Paint from the Third F-4 Aircraft, the First RF Series at Hill AFB on 3 July, 1985, R.A. Roberts, 17 July 1985.

4.0 PROJECT REQUIREMENTS

MECHANICAL PAINT REMOVAL SYSTEM

SPECIAL REPORT ON
PLASTIC IMPACT CLEANING MEDIA

PREPARED AND SUBMITTED BY

ROBERT A. ROBERTS

OO-ALC/MABEB

HILL AIR FORCE BASE, UT

84056

AUTOVON 458-~~853~~ 2042
2531

COMMERCIAL (801) 777-3534

NOTE:

ALL TESTS PERFORMED FOR THIS REPORT WERE THE RESULT OF ACTIONS TAKEN IN PREPARATION OF THE SUBMITTAL OF A "PRODUCTIVITY - RELIABILITY - AVAILABILITY - MAINTAINABILITY (PRAM) PROJECT FOR THE MECHANICAL REMOVAL OF PAINT FROM THE F-4 AIRCRAFT. TESTS WERE CONDUCTED FROM JAN 1981 THROUGH APRIL 1983.

TABLE OF CONTENTS

INTRODUCTION	Page
OBJECTIVES	1
SCOPE	1
BACKGROUND BASIS FOR THE PROGRAM	2
APPROACH TO THE PROBLEM	2
BASIS FOR RESEARCH	2
LITERATURE SURVEY	2
CONCEPT-GENERATION	3
INVESTIGATION OF CANDIDATE TECHNIQUES	3
INITIAL TESTS AND EVALUATION	3
PLASTIC BLASTING	4
ABRASION	4
EQUIPMENT LIMITATIONS	5
TEST RESULTS	5
EFFECTIVENESS OF THE BLASTING TECHNIQUE	6
EFFICIENCY OF THE TECHNIQUE	7
ECONOMIC ANALYSIS OF PLASTIC BLASTING	7
COST OF EQUIPMENT AND SUPPLIES	7
RECOVERY OF BLASTING MEDIA	8
DISPOSAL OF REMOVAL PRODUCTS	8
SAFETY AND ENVIRONMENTAL EFFECTS	8
CONCLUSIONS	9
RECOMMENDATIONS	9

P R E F A C E

The technique used most to remove protective and decorative coatings from aircraft is based upon the chemical action of stripping compounds against topcoat and primer materials. This technique is expensive and time-consuming, releases undesirable fumes into the work area, creates hazardous working conditions for personnel and results in removal products which are difficult and costly to dispose of without danger to the environment. Because of these adverse conditions, alternate methods of paint removal are required to meet these ever tightening restrictions by the Environmental Protection Agency (EPA). The method described herein, covers the use of a relatively new product defined as "Blast Cleaning Media" manufactured by U.S. Plastic and Chemical Corporation, Putnam, CT 06260, and now available under GSA Contract No. GS-005-56068. This material is a soft (Mohs 3/3.5) abrasive cleaning plastic with sharp angular surface characteristics that have excellent cutting qualities for the removal of paint systems. The distance between the work piece and the blast nozzle can be varied to provide the capability of removing a single layer of paint or as many as 14 coats of paint down to the bare metal. This material will not mar norpeen the substrates and is effective for the removal of carbon, grease, oil and dirt deposits.

The advantages of using the plastic media over the other types of organic blasting compounds (walnut shells for example) is that it is more aggressive and therefore requires less operating pressure to accomplish the same function (most tests were performed at 40 PSI delivery pressure at the nozzle). The plastic material does not break up readily and therefore produces less dust. It can be stored without deterioration, and can be dried and reused if it does inadvertantly become wet without adverse effect. Because it is man-made, it is consistant in both size and hardness and does not vary from batch to batch.

There are many mechanical paint removal proposals within industry which are in the development stage. Laser, Flash Lamps, High Pressure and CO₂ to name a few. Each of these proposed methods have proved that it is feasible to remove paint by mechanical means without damage to the substrate. The basic problem with these proposals is that there is a considerable time and money required to provide an operable product/process. The proposed Plastic Blasting method is available now, the equipment is categorized as "off the shelf" and the function of blasting is already approved in the tech data. This plastic blasting method could well fill the five-year development gap we are looking at right now for the methods outlined above, and could make it possible for us to meet the EPA standards for 1984.

There were limitations to the plastic blasting method, but in all cases, the limitations were far more desirable than the present chemical method and the follow-on operation of finishing with sandpaper or buffing pads. The blasting method is generally faster, cleaner, safer and therefore produces effective cost savings over the present methods. It cannot be used on honeycomb, soft fiberglass or plastics but will work on hard fiberglass and composite surface.

The plastic blasting method is not a cure-all, but it is available on an immediate basis and works well enough to warrant further and complete testing.

INTERMEDIATE REPORT

on

MECHANICAL COATING-REMOVAL TECHNIQUES

by

Robert A. Roberts
Hill Air Force Base, Utah
Ogden Air Logistics Command

INTRODUCTION:

Paint coatings are applied to aircraft surfaces to prevent corrosion and for aesthetic appearances; however, these coatings must be removed periodically during the repair and/or refurbishment cycles of the aircraft for several different reasons. Poor paint condition, deterioration, excessive coats of paint, and different types of paint overlaid on the same surface. The removal techniques now used require the application of chemical stripping compounds which are costly and have undesirable safety and environmental effects. An alternate removal technique is required. Therefore, as part of a designated P.R.A.M. program, these preliminary tests were performed in order to obtain the authorization necessary for the PRAM submittal, with the ultimate goal of obtaining the necessary funds required for the second phase of the test program - the stripping of large aircraft components with the plastic media.

OBJECTIVES:

The objective of this program was to identify and develop a mechanical technique for removing aircraft coatings efficiently and economically. The technique was to be an improvement over the existing walnut shell, or other organic blast materials presently authorized through Air Force TO 1-1-8 and TO 1F-4C-3-1-6. The technique was to be non-polluting with increased safety for operating personnel. The material was to be recoverable for reuse to provide cost savings in material and had to meet the EPA standards for pollution.

SCOPE:

The scope of the test program encompassed the mechanical removal of coatings from aluminum, steel, magnesium, titanium, fibre-composite and fiberglass: the coating systems were a combination of polyurethane, enamels, epoxys and acrylic and nitrocellulose lacquers. These "top coats" were over epoxy polyamide, rain-erosion and Koropon primers. The process would involve working with surfaces which had as many as 14 coats of intermixed paint, one on top of the other.

BACKGROUND BASIS FOR THE PROGRAM:

A considerable amount of time and money has been expended to develop paint systems which are tightly adherent to aircraft surfaces. A complete conversion program is in effect to change from lacquer to polyurethane on the F4 aircraft. With the F4 being in service for approximately five years between the Planned Depot Maintenance (PDM) operations, there is the possibility of excessive coats of paint, lacquer over poly (or vice-versa) and paint deterioration, all of which makes it mandatory to remove that paint system and apply new paint. The toughness of the paint makes the removal both difficult and costly, and in addition to the chemical removal, there is often a requirement to sand the stubborn primers from the surface. The final obstacle is the Environmental Protection Agency (EPA) who keep tightening the restrictions for chemical disposal through normal industrial sewer systems.

APPROACH TO THE PROBLEM:

The approach followed in this test program consisted essentially of three steps: (1) Identification of a media which would accomplish the mechanical removal of paint, (2) Test to evaluate the feasibility of the use of that material, and (3), To perform extensive tests on the selected media and to establish a technique for its use. The first step established the basis for the research; the second step eliminated the use of several types of media and their related techniques that were impractical, and the third step investigated the use of the selected material for as many applications as were deemed feasible.

BASIS FOR RESEARCH:

The basic problem with any Air Force program is obtaining the necessary funds required to see that program to completion. Funds were necessary to provide special equipment and facilities capable of performing the function of paint removal in a controlled area. The "Productivity-Reliability-Availability-Maintainability (PRAM) program was selected because the Plastic Blasting Media is new and has never been used to perform the paint removal function. As a new item, it would meet the criteria for the PRAM which would provide the funds on an immediate basis without submission of a Military Construction Program. The PRAM has been approved for the first testing phase and is now ready for submittal for phase two which will provide an item of equipment large enough for the paint removal operation for a complete F4 aircraft.

LITERATURE SURVEY:

Test documents, which were a result of Government funded test projects for the mechanical removal of paint from aircraft were reviewed. For the most part, the literature dealt with the evaluations of existing media, such as walnut shells, nut and fruit pits and rice and wheat hulls. In most cases, the blasting method was discarded because the abrasive quality of the materials did not meet the paint removal requirements. The Battelle Test, performed in 1979 with High Pressure Water and Carbon Dioxide pellets seemed to be the most promising at that time. The pressures required for these operations was greater than that allowed on the aircraft skin surface and therefore were not continued. Other abrasive blasting techniques reported were largely too aggressive for use with fiber-

composites and thin metal substrates used on aircraft, as well as the honey-comb surfaces which could be delaminated with excessive blast pressures. Most of the tests performed were not sufficiently aggressive or were too-small scale for application to aircraft coatings. A few of these items reviewed contained information on paint removal which was of interest to this test program, but mostly has provided background data.

CONCEPT - GENERATION:

The function of paint removal by blasting was addressed without limitation. No constraints were established other than something which would cause damage to the varied substrates. The commercial field was accessed for a material which would accomplish the end function better than what had been available in the past. The discovery of the plastic media produced by U. S. Plastic and Chemical Corporation provided the basis of the test program shortly after the first test blasting operation. The previous testing with the aggregate materials was discontinued and the tests were directed towards the use of this new media which was soft but aggressive at the same time - provided a relatively safe operating atmosphere, was reusable and relatively inexpensive. This media answered most of the test parameters and was available on the commercial market.

INVESTIGATION OF CANDIDATE TECHNIQUES:

With the discovery of this newly developed Plastic Media, the previous testing with walnut shells was discontinued, and all efforts were directed toward developing a technique for the use of the plastic. The preliminary investigative process proved that the plastic did the same amount of work quicker, with less dust generated and at a much lower delivery pressure.

INITIAL TESTS AND EVALUATION:

The primary purpose of the initial tests were twofold: First to prove that the new plastic media met the pre-established requirements of the program, and second, to gain the approval of the PRAM project review personnel at OO-ALC level. The plastic media was capable of removing paint from the many varied surfaces, and the areas where it would not work were defined. The initial tests proved that the other methods were not economically feasible with the present state-of-the-art development. Test coupons were prepared by the Chemical Laboratory who provided these coupons in recorded materials and weights in order to determine the damage and weight loss after blasting through metallurgical analysis. The test coupons, in anodized aluminum, alclad aluminum, hardened aluminum, raw steel and cad plated steel were pretreated in accordance with the requirements of TO 1-1-8 and were primed and painted (poly over epoxy). In addition, doors and panels, removed from operations F4 aircraft during their PDM program at the Depot, were used to determine the effects of the blasting media on actual sections of the F4 aircraft with aged, multi-coated and deteriorated paint systems. Each of the initial tests were performed on the test coupons and then the same test was performed on the actual aircraft part. All

blasted coupons were delivered to the Metallurgical Laboratory for analysis for the official report. This first report was received with great expectations, but several of the test parameters showed that soft metals (alclad) was moved on the surface (although no metal loss was detected). It was decided that additional testing would have to be performed to verify the metal movement and to test the new blast method against the present method of paint removal at the depot.

PLASTIC BLASTING:

Commercially produced Plastic Media in the 12/16 screen/mesh size was obtained from U.S. Plastic and Chemical Corporation. This material was loaded into a standard-off-the-shelf Vacu-Blast machine, Model Nr A-1 UTILITY VACU-BLAST for the test program. The Vacu-Blast machine was used because it was available for immediate use along with a locally manufactured Glove Blast Booth. The Vacu-Blast machine operates on standard shop air and the nozzle delivery pressure is totally adjustable. It was soon discovered that the best operating pressure at the nozzle was 40 PSI (lower pressures worked poorly, while the higher pressures did not seem to work any better and therefore did not warrant the effects that high pressures have in blasting). All further tests were performed at 40 PSI. The nozzle diameter was $\frac{1}{2}$ inch with a carbide lined nozzle which when measured after the test, showed no sign of wear whatsoever. The stand-off distance (workpiece to nozzle) varied with the type of paint to be removed, the amount of paint or the type of work being performed. The test coupons were blasted at a distance of 2 inches to provide a measurement factor to base substrata damage on during the test cycle. Examples of distance and the work performed are: From a distance of 6-8 inches, a single top coat or decal/stencil could be removed without affecting the paint underneath. The closer the nozzle to the work, the more paint was removed and in a less amount of time. The one exception was the DeSoto Koropon Epoxy Primer which has been on the surface for approximately 17 years. This material was very difficult to remove and is also the same material which must be sanded off the surface when chemical stripping is performed. The tests proved that it was possible to leave this tough primer in place by discontinuing the blasting when this surface was reached. It was also found that this surface could be repainted easily with no ill effects because there had been no chemical attack to the surface.

The "green" paint was easily removed with no relative abrasion to the base metal. The Alclad was intact with very little damage, the anodize showed no abrasion at all and the hardened aluminum showed spotty impact marks. The steel showed no abrasion marks whatsoever. All tests were again performed on the "green" coupons so that metal loss could be measured during the final analysis in the metallurgical laboratory.

ABRASION:

During the test program described above, a similar test was conducted using chemicals to remove the paint and then followed with the standard depot abrasion method of wire brushing and/or sanding to remove the stubborn paint to bare metal.

Each operation was conducted on an actual section of the aircraft and then repeated on the test coupons. In all cases, the chemical/sanding method showed from 40 to 400 times the metal loss during the verification weighing. The blasting method did show an abrasion of the soft alclad surface, but later tests showed that this surface provided a more tenacious surface to paint to, proving that the blasting method was more beneficial than destructive.

EQUIPMENT LIMITATIONS:

It was discovered that the higher supply pressures at the nozzle did not improve the effectiveness of paint removal. The geometry of the equipment was such that the maximum velocity in the jet stream was probably reached at the supply pressure of 40 PSI. Although the Plastic Media did become more aggressive at the higher pressures, the end results were not proportional to the increase in pressure and the nozzle was easier to handle and control at the lower pressure. All tests were performed in a locally fabricated "glove box" type blasting booth.

TEST RESULTS:

The test results for the standard coupon specimens were basically as expected. The paint was removed in a relatively short period of time which verified that the plastic method of paint removal would be effective for that type of work. Other test items were submitted to the test blast with the following results.

Hand Layed-up Fiberglass: This material resisted the attack of the plastic blast until the paint surface was disturbed. At that time, the blast continued through and damaged the fiberglass surface. The analysis for this type of an operation was therefore negative and would not be suggested for use.

Dead Soft Aluminum: This type of material is used in the F4 aircraft as the cooling unit for the air conditioner. The paint could be removed from the surface with a stand-off of 6-8 inches, but anything closer than that would penetrate the surface and cause a fast breakdown on this soft and thin metal.

AIM-9 Missile Nose Cone: This item consisted of an optical glass nose section connected to pressure set-up fiberglass which was bonded to aluminum. The plastic blast method removed paint from the fiberglass with no apparent damage, cleaned the aluminum and showed no deterioration of the optical nose piece. The aluminum flash coating on the fiberglass section was not retained however, so the test results received varied acceptance. The test was decidedly a success - the process could be used to perform the paint removal function of this item.

Epoxy Cast Fiberglass: The media removed the paint from the surface to any degree required. This would be an acceptable method of removing paint from composite surfaces due to the initial surface hardness during the fabrication of the composite. It was also discovered that backing off on the stand-off distance would produce varied results - like removing a single top coat of paint and leaving the primer in place.

Dirt/Grease Removal: Casting sections of the F4 landing gear were blasted to see if they could be cleaned without solvents of any type. The test was a complete success with all dirt/grease being removed from all crevices with no apparent damage to the painted surface. Again, it was the difference in the stand-off distance that accomplished the operation. During this test, dirt, old dried grease and paint were removed from a swivel bearing surface. The blasting removed all of the dirt, grease and paint and did not effect the operation of the bearing. As further proof, a bearing was subjected to packing with the plastic media and all that happened was that a like amount of grease was displaced. No abrasive action took place on or in the bearing surfaces.

VariRamp Louvers (F4): These louvers are made of magnesium and have a titanium screen wired in place with stainless steel wire. Cleaning time by hand was 1.3 hours each. There are 12 louvers on each F4 aircraft. A special test was conducted to see if the chemical removal time could be shortened. The items were placed in a tank of paint stripper and allowed to soak for a period of 5 minutes - they were rinsed with water and then the paint blasted off while the paint was still soft. Removal time for blasting was less than 4 minutes for each item. A continuation of this method will be accomplished on larger end items during the next testing phase.

EFFECTIVENESS OF THE BLASTING TECHNIQUE:

The tests have easily removed all types of paint surfaces. The lacquer was removed the easiest, followed by the polyurethane and then the epoxy. The Koropon epoxy coatings were the most difficult of all, requiring multiple passes across the surface. The output pressure was increased in increments of 10 PSI with very little result. It is believed that the hardness of the aged Koropon epoxy primer (applied in 1966) was harder than the Plastic Media, and therefore required the multiple pass effort for removal. A typical time phase was one minute to remove polyurethane paint from a 4 x 6 inch coupon. The same area covered with Koropon took 4 minutes and even then, all of the primer had not been removed from the surface. (A harder, more aggressive Plastic Media may solve this problem and will be evaluated in the next testing phase.)

The damage to the substrate was negligible in all cases after the 40 PSI pressure had been established. Even the dead soft aluminum showed little sign of damage when the blast nozzle was held the nominal 6-8 inches from the surface. Soft aluminum shows the impact of the sharp edges of the plastic, but tests have proved that this provides a surface with a better "tooth" to paint to and provides a finish product that does not indicate the blasted surface.

In retrospect, single pass removal of paint cannot be considered the criterion for effectiveness, chemical stripping itself is not totally effective, as it generally requires more than one application of stripping compound to remove both topcoat and primer. Sometime, mechanical means must be used in conjunction with the primer to remove all of the paint to bare metal. It is this mechanical means, whether it be scrapers, aluminum wool, fine wire brushes or

flap brushes, generally causes some metal loss during the process. It is this metal loss that can be eliminated with the use of the blasting type method and the plastic media compound.

If only the topcoat is to be removed, allowing the primer to remain in place, the plastic blast method is totally acceptable. With the use of chemicals, the primer paint is generally attacked in some manner, and even though it is allowed to dry, when new paint is sprayed on top of the old primer, it generally brings some of the stripper out and causes painting defects. The old primer seems to have the ability to hold some of the stripper to cause this effect. In cases where it is unnecessary or undesirable to strip the aircraft to bare metal, and in order to decrease the time required to accomplish the job, the plastic blast method is acceptable. The stripping compounds presently in use are not selective in their action, but attack the topcoat and primer indiscriminately. Once they are applied to a coating system, their depth of penetration cannot be controlled. Plastic blasting on the other hand can be totally selective in the number of coats removed, or the depth of the removal operation.

EFFICIENCY OF THE TECHNIQUE:

In the stripping operation observed at Hill Air Force Base, 6 shifts were required to remove the major portion of the paint from an F4 aircraft and three drums of non-phenol stripper were used. The number of workmen varied among the different shifts, but the time standards are based on a five man crew. The total man-hours for chemical paint removal averaged 300 hours. At that point in time, the remainder of the paint left on the aircraft, which could not be removed with the stripper, was removed using orbital sanding devices with 180/320 grit sandpaper. This operation consumed an additional 270 man-hours.

ECONOMIC ANALYSIS OF PLASTIC BLASTING:

The tests performed to date do not provide the data necessary for a true economic analysis. The tests were performed on equipment which was sized for the test program, not for an operational facility. The proportional increase in capability is illustrated by the initial blasting tests performed with a 3/4 inch nozzle blasting machine using walnuts as the media. This machine was capable of removing the paint from an F4 wingfold (approximately 350 square feet) in less than 15 minutes. The tests with the new Plastic Blasting Media have proved that it is possible to reduce the time by approximately 35 percent while eliminating the health and safety hazards previously associated with walnut blasting procedures. This indicates that the same amount of area can be stripped of paint with the PBM in approximately 10 minutes. The second phase of the testing program will provide suitable sized equipment for use on large aircraft components. This second phase will verify the increased time savings which have been estimated to date.

COST OF EQUIPMENT AND SUPPLIES:

The plastic blast media used was donated by U.S. Plastic and Chemical Corporation who provided enough quantity in each of the screen sizes to accomplish the test base information. The final selection of the media in the 12/16

screen size was based on the ability to remove paint and the amount of material which could be recovered. The "Glove Booth" used provided a gravity flow to the vacuum assist return line to the Vacu-Blast main hopper. This provided total reuse of the material considering that the particles of plastic which were reduced to dust size were taken off into the dust bag unit. The cost of the equipment is a relative item. The size of the unit regulates the cost, and the number of units used at one time increases that cost proportionally. It is estimated that a small blasting system can be set up operationally for under \$7,000 which will handle end items with a maximum size of 18 x 36 inches (flat stock). The cost of the blasting media, as per the 1983/84 GSA Supply catalog, Contract Nr GS-00S-56068 is \$1.73 per pound; and is covered in their special item numbers: NIS-G-5985 and NIS-G-7191, 5350 Class.

RECOVERY OF BLASTING MEDIA:

The "A-1 Utility Vacu-Blaster" used has a vacuum return system which allows the blasting media to return to the delivery hopper for reuse. It was discovered that approximately one pound of the media had to be added to the machine for each hour of operation. The loss of this media was due to the breakdown of the media to finer sized particles and being diverted to the dust collection system of the blasting equipment. We believe that under the correct type of conservation program, that this finer screen grade material could be used to perform the blasting on delicate and critical areas (such as electronic module boards) and that the loss would be categorized as a total loss when it was finally as fine as powder. This would be another total testing program and will not be addressed herein other than this recommendation.

DISPOSAL OF REMOVAL PRODUCTS:

All paint systems removed as a result of the blasting operation were disposed of as solid waste. No residue was left on the blasted surface other than a slight dusting film which was easily removed with a blast of low pressure air (30 PSI). It was discovered that the paint particles removed during the blasting operation were returned with the blast media through the recirculation system and actually aided the removal of paint. In all cases, disposable product was in the form of dust collected in the blasting machine's dust bottle. This disposal operation was accomplished after approximately 6 hours of intermittent operation with a two quart dust bottle.

SAFETY AND ENVIRONMENTAL EFFECTS:

To qualify as an acceptable alternative to chemical stripping, a coating removal technique must not generate environmental or safety problems that cannot be solved technically and economically. The importance of this requirement increases as the effectiveness and efficiency of the removal process approaches that of chemical stripping. Elimination of the use of chemicals was the projected goal of the mechanical blasting operation. The Plastic Media proved to be more efficient than walnut shells, eliminating the basic dust

problems and the explosive hazards associated with the use of walnuts. Being able to use lower operating pressures reduced the personnel safety factors associated with breathing air and protective equipment. The Plastic Media material will not sustain bacteria during storage and will not form mildew or mold. Each of these were contributing factors for the selection of U.S. Plastic Media. Regular clothing with the use of a breathing air hood, gloves and an apron were adequate protection during the test period in the open hangar area, with no after-effects noted for any of the personnel performing the test. In actual production operation, the dust collector system will not contaminate the environment and will meet all of the EPA standards for operation of blasting equipment.

CONCLUSIONS:

Of the coating removal techniques investigated in this test program, only the plastic blasting held any promise for aircraft repainting applications. The walnuts produced more dust that was considered allowable for the type of work being accomplished. There was a greater resuability factor with the plastic because it did not break up as readily as the walnuts, and this therefore produced a lower consumption ratio. The elimination of agriculture inspections, storage problems, moisture contamination and the reproducibility of the media without fear of changing or altering the hardness, all contributed to the selection of the plastic blast media. The pulse-laser, flash lamp, solid CO₂, extreme high water pressure and other hydro methods are all proposals which could work into a non-chemical method of stripping paint from aircraft surfaces. All of these however, are not available and will take time for the research and development necessary to make them cost effective to use. Walnut shells have been used for years for blasting and have been proved effective. The addition of the Plastic Media to this method has increased the stripping ability and it is a method that can be used immediately without new design of equipment or facilities.

The plastic blast is a "today" method of improving the system of paint removal which will meet the EPA restrictions for contamination and disposal, while using the machine technology of today in the off-the-shelf blasting equipment which is available from several manufacturers.

RECOMMENDATIONS:

The first phase of the tests required for submittal of a PRAM project has been successfully accomplished. All metallurgical reports support the process of paint removal without damage to the substrate on the F4 aircraft. In addition, the pre-softening of the paint surface with chemicals and then removing that softened paint with the plastic blast is a logical progression for the next phase of the test program. This would produce a solid waste which could easily be disposed of in land fill operations without contamination to our water supply and will eliminate the costs involved in cleaning chemically contaminated water. The recent EPA restrictions on the amount of organic solids allowed to enter water streams make this a very viable method to consider. The

preliminary tests for this type of operation have been accomplished and would fit logically into a larger aircraft component test pattern.

Phase II of the PRAM submittal covers the extension of the program by procuring a larger blasting machine and providing a 75 foot square space to accomplish the test program. The approval from the F4 Engineering Management organization (MEET) for the use of the plastic media allows the PRAM project to be submitted to higher headquarters for allocation of the necessary funds to continue the program. The plastic media has been accepted by GSA/FSS as a suitable substitute for walnut shells to accomplish blasting operations, and is now, under GSA NIIS Contract No. GS-00S-56068, and is considered by GSA to be functionally similar to products specified under MIL-G-5634C. The material is available for use, the equipment is available for use, all we need to do is to put it all together to provide an operational production facility for the removal of paint from the major F4 components.

The plastic media is also capable of removing heavy soils from inaccessible areas where it would be difficult to impossible to use chemicals, or where chemicals would be considered unsafe in private industry for the removal of grease and dirt from internal combustion engines, deburring without surface distortion, removing encapsulated compounds from electronic components/modules, deflashing plastic parts and the preparation of electrical leads for the removal of resin smear. This test program is the first considered for paint removal from aircraft and this method is now being considered as the intermediate step for paint removal to meet the EPA requirements while the exotic methods are being worked through their research and development phases.

It is recommended that a facility be allocated for the accomplishment of the designated "Phase II" of the PRAM program and that funds be made available for the procurement of equipment large enough to handle large surfaces. This complete facility would be considered as a production blast operation and would easily support the present Planned Depot Maintenance workload for the removal of paint from the F4 component parts. Processes must be developed for the use of this equipment and the new plastic blast media on specific aircraft parts, and when the system successfully removes paint from the components, the PRAM Phase III for removal from paint from complete aircraft can be accomplished in the same facility using the same equipment.

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WET PROCESS CAN GET CORROSIVE CHEMICALS INTO INNER SURFACES, CRACKS, AND THE ENGINE. THIS CORROSION CAN CONTINUE EVEN AFTER THE AIRCRAFT IS PAINTED.

M E C H A N I C A L P A I N T R E M O V A L P R O C E S S

INTERIM REPORT ON

Stripping Paint From the First F-4E Prototype at Hill AFB, Utah on
31 July 1984

Prepared and Submitted on 21 January 1985
By

Robert A. Roberts
OO/ALC/MABEB
Hill Air Force Base, Utah
84056-5149

AUTOVON 458-3534/2042
Commercial (801) 777-3534/2042

NOTE:

The removal of paint from the first prototype F-4E Aircraft was part of the second stage of the "Productivity-Reliability-Availability-Maintainability (PRAM) Project Number 00-143

TEST REPORT

TITLE

Paint Removal From F-4 Aircraft Using The Plastic Bead Blast Process.

AIRCRAFT PROCESSED

F-4E Serial Number 68-0345, 35th TFW, George Air Force Base, California.

PURPOSE

The purpose of the test was to strip the paint from a complete F-4 aircraft using the Plastic Bead Blast process; to determine the adequacy of the process and to define the problems associated with this method of paint removal.

FACILITY

The northwest bay of building 236 was used to perform the prototype test. This building is the maintenance fuel dock, therefore the floor drain had to be sealed and all of the fuel associated equipment within the bay had to be covered.

EQUIPMENT

Four blast machines were contractor provided as follows: CLEMCO-1.5 cu. ft. with 5/16 inch nozzle: CLEMCO-10 cu. ft. with 1/2 inch nozzle: PAULLI & GRIFFIN-10 cu. ft. with 1/2 inch nozzle and CAB-7 cu. ft. with 3/8 inch nozzle. All machines were adjusted to 40 PSI outlet pressure at the nozzle. The CLEMCO-1.5 and CAB-7 were loaded with 16/20 mesh size plastic material and the CLEMCO-10 and PAULLI & GRIFFIN-10 were loaded with 12/16 mesh.

PERSONNEL

Seven personnel were assigned for the blast operation, two of which were trained in the Plastic Blasting Process. All seven personnel plus the Project Director rotated between the blasting operation and the "sweep and shovel" recovery method which was required to keep the machines loaded.

AIRCRAFT SELECTION

The aircraft selected had the original Koropon epoxy primer and an average of eleven coats of paint. These consisted of lacquer, epoxy and polyurethane. This was the first complete stripping action since the original paint in 1968. The paint was peeling, flaking, and chalking and had been oversprayed in the field without feather sanding. The paint finish met most of the repaint criteria as established in TO 1F-4C-3-1-6.

AIRCRAFT PREPARATION

The aircraft was washed with Alkaline soap and delivered directly to building 236, bypassing the disassembly operation, leaving the engines, wingfolds, stabilator, and tail cone in place. Aircraft jacks were installed and the landing gear raised. The aircraft was a nominal 6 foot 6 inches off the floor to provide easy access to the belly. The canopy, nose radome, engine intakes and exhaust were taped and covered with barrier paper. All drain holes were plugged with plastic cap plugs and odd shaped

access holes, such as the vari-ramp louvers, were plugged with soft polyethylene plastic foam and covered with 3M507 Tombstone tape. A 1/4 inch blast nozzle was used to spot identify every plate on the aircraft to record the location of those plates covered with "ALCLAD" for special blasting with the 16/20 sized media.

SPECIAL PRECAUTIONS

All personnel within 25 feet of the blasting operation were required to wear ear plugs, goggles, protective paper hoods, dust masks and paper coveralls. Personnel performing the blasting operation were supplied with fresh breathing air blast hoods, ear plugs, coveralls and gloves. Barrier ropes were erected to cordon-off the area for visitor observation.

BLASTING OPERATION

The blasting operation started at 0915 hours with all four machines in the blasting operation. The CLEMCO-1.5 and CAB-7 were used to blast strip the paint from the plates identified as ALCLAD, the fiberglass FIN cap, radar windows and formation light units. The anodize coated aluminum, steel, stainless steel, magnesium and titanium were all blast stripped with the 12/16 sized media. The blasting operation continued through the 12th shift period with blast personnel working a staggered shift to maintain at least two of the machines in constant use. At 1330 hours the air supply to the blast machines became contaminated with water and the complete operation came to a standstill until the water could be blown out of the air lines and the wet media removed from the machines. This caused approximately four flow hours delay in the total operation schedule. The complete operation was timed by engineering standards personnel who recorded the actual nozzle-on time for blasting. The final report showed 39 actual blasting hours. The aircraft was completed at 2210 hours, for a flow time of almost two shifts. The lost time due to water and the time required to shut the machines down during the loading operations accounted for the additional flow shift over the original estimate of 30 hours/one shift.

PROBLEMS

The untrained personnel used the wrong angle of deflection and blasted the protective tapes off the openings. This allowed the blast media to enter the aircraft in large quantities.

The soft polyethylene foam was a poor selection for plugging odd shaped holes. The blast media was allowed to enter the internal surfaces of the aircraft through improper and poor fitting plugged areas and the soft foam was blasted away.

All four of the blast machines should have had 1/2 inch nozzles installed. The blast rate of the 5/16 nozzle was less than 1/4 of the 1/2 inch nozzle. This caused additional nozzle-on time over the original estimate.

The 3M507 Tombstone tape was inadequate because it did not stick well enough to the aircraft surface unless a sub layer of cloth duct tape was applied. A better mastic is required for production use.

A special water separator or refrigerated air dryer is required to eliminate the problems associated with water contamination.

The area behind the vari-ramps was extremely difficult to blast due to the restricted angle of attack. The four foot external area inside the forward end of the engine intakes fall into this same category.

The time expended on the belly of the aircraft was almost double that of vertical and horizontal upper surfaces. The stand-off distance of the hand-held nozzle was too close which defeated the spread design of the nozzle. This close angle was also extremely fatiguing for personnel.

The original assessment of the aircraft was in error in the hole plugging category. There were many holes which were not plugged, and as a result, approximately 20 pounds of the blast media was initially removed from the internal sections of the aircraft during the plate removal shakedown operation.

DEFICIENCIES - FINDINGS - RECOMMENDATION

The plastic face plate in the blast hoods is a detriment. Special hoods with glass face plates must be made available for this type of blasting.

A request has been submitted to 3M to change the mastic on the 507 tape to make it stick as well as the duct tape.

A special unit has been designed and fabricated by Royce Mechanical Systems for blasting the belly of the aircraft. The unit has been designated as the RAR-100 "Blastmobile". This unit will allow personnel to blast the belly from a comfortable position and the correct distance from the surface.

The standard "sand blast hose" is too heavy for the plastic blasting operation and is very fatiguing. Special hoses have been ordered from Germany which perform the function at half the weight.

Special extension nozzle inserts have been fabricated for blasting the inlet housing to the engines and the restricted space between the fuselage and the vari-ramp.

Special mechanical plugs have been designed and fabricated to plug the holes (air conditioner inlet-73, Door-69, Door-Gun vents, etc.) to eliminate major media ingress.

A special cover has been designed for the canopy to eliminate taping times and to protect the canopy during the blast operation. Foam weather stripping will be used to provide a better seal in the canopy jamb area.

The ability to see is a critical requirement. Special fluorescent portable lights will be used to provide additional light as required. The new facility is designed to 200 foot candles of light at the six foot working level.

Access to the aircraft was a problem. The special hi-lift unit worked well but was very difficult to maneuver. Special F-4 maintenance stands have been designed and fabricated (Up-Right Scaffold Company) to provide access to the complete aircraft from both sides at the same time.

Continuing tests have been performed on the effect of the 12/16 size media on ALCLAD coated aluminum surfaces. As a result of these tests, the complete facility has been converted to 30/40 size blast media. The only difference noted with the use of this finer material is that the stand-off distance has been shortened. The resultant blasted ALCLAD surface is acceptable for painting without sanding or buffing.

Ingress of the blast media into the aircraft was the only major problem. The M-31 20MM gun was easily cleaned as was the air conditioner unit which had been removed from the aircraft due to excess media contamination. Special extension tubes have been designed and fabricated to assist the standard air-vac unit in the removal of the plastic from "hard-to-get-at" areas (inside flaps, etc.). The vacuum along with low pressure (30 PSI) air was all that was necessary to remove the plastic.

The fuel, hydraulic and pneumatic systems were tested after the aircraft had completed the PDM depot cycle. No contamination of these systems was identified. Standard precautions for plugging open lines seem to be adequate.

A total of 390.8 hours were recorded for cleaning the blast media. Of this 75 percent or 293.1 hours were covered through the normal PDM cleaning prior to closing access doors. The additional cleaning time attributed to the blast media therefore was 97.7 hours. This additional time should be reduced drastically with the use of positive mechanical plugs. A review of the "CYBER" control documents will be accomplished to define the actual cleaning required after blasting which is not part of the present cleaning operation.

The first prototype F-4 was successfully blasted, (in 39 hours) no major deficiencies have been recorded which resulted from the blasting process. The second prototype will be disassembled prior to blasting so that the process will fit into the present CYBER operations. All major components removed during the disassembly operation will be blasted along with the aircraft to record a full aircraft blasting time allotment.

STATUS OF PRAM PROJECT 00-143

The original plan divided the program into three stages:

Stage 1 was the removal of paint from aircraft component parts. For the past six months, this has been a successful operation within both 00-ALC/MAB and MAN.

Stage 2 was the removal of paint from the leading edges. This operation was changed to a full prototype F-4 aircraft blast stripping so that a greater learning curve could be established, first using an aircraft with all components (including engines) in place, and the second the standard partially disassembled aircraft as they are presently input into the planned depot maintenance program.

Stage 3 was scheduled to be a full aircraft stripping operation with all of the information programmed into that operation which was learned during the first two stages. The completion of these three stages was scheduled to be completed concurrent with the completion of the PRAM Blast Booth, for the logical step into production aircraft blasting.

As of this writing, the PRAM Blast Booth is 75 percent complete and should easily meet the 28 February 1985 turn-key date. There are 360 test coupons (3 x 6 inch) in different types of metal with different finishes. These coupons are being evaluated by the Metallurgical Laboratory at OO-ALC to provide test data for OO-ALC/MMS and MME for final approval of the blast stripping process.

In order to continue with the planned PRAM program, a "request for waiver" will be forwarded to HQ-ALC/MAX to lift the present ban on stripping complete aircraft. The present PRAM program is at a standstill awaiting approval of the waiver.

The second prototype F-4 will be blasted under the control AF and AF959 "work control document" which will be converted to tech data after a successful blasting operation. This document will also be used to establish the correct blast procedures in the CYBER for continued production blasting. The second prototype will be blast stripped in building 236 using the same basic process and precautions as the first F-4.

SUMMARY:

The first prototype F-4E blast operation was a qualified success. The aircraft was totally stripped in 39 hours without damage to any of the substrate. The programmed time to accomplish the same operation with chemicals was 341 hours. There was 120 pounds of dry waste after the operation was completed. This waste was tested for contaminants and did contain 12.2 PPM Chrome (from the Chromate Primers), a small trace of lead (from pigment in lacquers), and a very small trace of Cadmium (from protected steel). The waste was packaged in a plastic lined steel drum and processed accordingly. The identification of the problems associated with this prototype was a valuable tool in the continuation of the PRAM Program, and does place the program in the correct perspective in accordance with the original plan of operation.

The new PRAM facility (identified as Building 223 at Hill AFB, UT) is scheduled for completion on 28 February 1985. The accomplishment of the scheduled tests comply with the completion date of the facility. It is in the best interest of the Air Force that the tests continue as scheduled.

FINAL PAINTING:

F4E Serial Number 68-0345 was released from Flight Test on 14 January 1985 and delivered to the painting and preparation facility (Bldg 220). The aircraft was washed with alkaline soap, rinsed, brightened, de-smutted and conversion coated without any abnormal problems. There was no evidence of plastic media in faying, form-in-place seal or in butt joint areas. The surface accepted the cloth wash/wipe rags without adverse effect and the aircraft was cleaned and prepped for painting in less time than the normal aircraft stripped with chemicals. Part of this "less time" notation was due to the fact that the gummy type residue from chemical strippers was not evident and the total surface of the aircraft was generally smoother. In addition, many of the compound curve areas on this aircraft were blast stripped to bare metal which is not generally accomplished during chemical stripping due to the time consumed for that type of operation. This made it easier for the painter type people because of the reduced amount of sanding required to make this aircraft ready to accept paint.

The painters requested that the internal area on the underside of the wing under the dive brake and the outside ribs of the flaps and ailerons be blasted so that the 'touch-up' operation with red or white paint could be accomplished without feather sanding. They also requested that the attached section of the formation lights be blasted to eliminate the necessity of sanding this very thin fiberglass section.

The final acceptance was the profilometer test. The OO-ALC/MAQM Metallurgical Lab used a Gould Surfanalyzer, Model ADP 22, Number 4261. The machine was self calibrated to 125 microinches with the Calsure Certified Roughness Standard at the test site. The average surface reading was 171 to 209 microinches tested at the trailing edge of the wing, the flap, leading edge flap and upper wing surfaces. These measurements were verified against a flap which was painted at the bench which had a surface roughness range of 165 to 185 microinches. To further verify the test readings, the surface of an F-4 aircraft which had been scheduled for chemical stripping was measured. The average surface readings were 145 through 179 for an operational aircraft. The final analysis of the roughness test for camouflage painted aircraft proved that this aircraft finish was no different than the chemical stripped aircraft produced at Hill Air Force Base.

The DCM at George Air Force Base in California will be advised that 68-0345 is the first prototype operational F-4 aircraft in the Air Force inventory which has been stripped with the new blasting process. He will be requested to monitor the finish on this aircraft and report any anomalies during the first year of operation.

ADDITIONAL SUPPORT DATA

For those who receive this report and are not aware of some of the previous problems associated with the Plastic Bead Blasting, the following is submitted:

The aluminum surfaces of aircraft are coated with two vastly different materials: ALCLAD and ANODIZE.

"ALCLAD" is the physical coating of the mother substrate with pure aluminum which is from 1 1/2 to 5 percent of the thickness of the mother metal. This adds weight to the mother metal but does not provide any additional strength. An example, for a finish given thickness, such as .032, the thickness of the mother metal would be .026 with .003 pure aluminum on each side to make up the total of .032. The pure aluminum provides a cathodic coating to protect the mother metal from the products of corrosion.

"ANODIZE" is an electroletic coating applied to the outer surface of the aluminum only, and which produces a hard coating and isolates the aluminum from the products of corrosion. It adds no appreciable weight to the mother metal and somewhat increases the strength of the mother metal by increasing the hardness of the outer surface.

When either of these two finishes are damaged or the surface is going to be painted, the standard process of Phosphorizing (brightening), desmutting and finally conversion coating (alodine) is performed to ensure an adequate bond surface for paint.

The original objections voiced against the blasting process was that the blasting would make the "ALCLAD" surface extremely rough and therefore would not produce an operational or acceptable finish. The follow-on testing program established that the 12/16 plastic media originally used was too rough, and the final test showed that the 30/40 media produced an exceptional finish which actually provided a better surface for the paint to stick to. All production F-4 blasting will specify the 30/40 material to ensure the surface finish is acceptable.

P L A S T I C M A T E R I A L B L A S T I N G - P M B

INTERIM REPORT ON

STRIPPING PAINT FROM THE SECOND F-4E PROTOTYPE AT HILL AFB, UTAH
20 May 1985

PREPARED AND SUBMITTED ON 20 MAY 1985
BY

ROBERT A. ROBERTS
OO-ALC/MABEB
HILL AIR FORCE BASE, UTAH
84056-5149

AUTOVON 458-3534/2042
COMMERCIAL (801) 777-3534

NOTE:

THE REMOVAL OF PAINT FROM THE SECOND PROTOTYPE F-4E AIRCRAFT IS PART OF THE THIRD AND FINAL STAGE OF THE "PRODUCTIVITY-RELIABILITY-AVAILABILITY-MAINTAINABILITY (PRAM) PROJECT NUMBER 00-143.

Test Report:

TITLE

Paint Removal From F-4E Aircraft Using The Plastic Material Blasting (PMB) Process

AIRCRAFT PROCESSED

F-4E Serial Number 68-0448, Destination after PDM - St Louis ANG

PURPOSE

The purpose of this second test was to verify the PMB process in the newly constructed blast booth designed specifically for this procedure.

- a. To determine the adequacy of the equipment.
- b. To record the paint removal rates using five blast hoses.
- c. To establish the best nozzle pressure for paint removal.
- d. To verify the use of specially designed mechanical plugging devices.
- e. To verify the use of the "Blastmobile" for blasting the belly.
- f. To validate and verify the facility.

FACILITY

The new blast booth is identified as Building 223, located adjacent to the southeast corner of Building 220 in the Maintenance Directorate (east area of Hill AFB). Dual occupancy was granted by the contractor prior to actual scheduled completion date (5 June 1985) so that this test could be performed, and to provide time for any required modification to the blast booth.

EQUIPMENT

The blast booth is a complete entity. It is 45 feet wide by 75 feet long and is 20 1/2 feet high to the drop ceiling. The booth has a complete wall-to-wall floor recovery system which operates on the pneumatic/vacuum principal. The floor contains 88 each 2 x 4 inch steel tubes with deflector plates which guide the spent plastic media to over 6700 holes for moving the plastic material through the tubes to the classification system. The classification system consists of two vibrating screens which mechanically separate the reusable plastic media from the dust. The plastic hopper is capable of storing 6,000 pounds and is located directly over the five Pauli & Griffin seven cubic ft blast machines, each with a 75 foot hose and 1/2 inch blast nozzle. The dual air system moves the air from the ceiling to the floor through registers. All air is returned through the floor to the booth through two dust collectors. The mechanical plastic material classification system can handle up to 1500 pounds of plastic material/dust per hour for complete recovery and reuse of the blasting material.

NOTE: For the purpose of this test, two nozzles were set at 30 PSI and the other three were set at 40 PSI. The purpose of this is to obtain paint removal rates at the two different pressures and define the best nozzle blasting pressure. The Work Control Document (WCD) (AF Form 959) describes

the areas which were blasted with the different pressures - the amended version of this WCD is submitted as Attachment #1 to this report. The updated version is Attachment #2 (to be used on the next aircraft).

PERSONNEL

Eight personnel were designated for the blasting operation. Five of these people were provided by the Aircraft Division production aircraft stripping shop (MARPSF), two having previous aircraft blasting training and the other three minimal training. This provided one person on each of the five hoses at all times. Two Master Sergeant from TAC and AFRES volunteered their services for this test program and acted as relief blasters. Neither of these two people had any previous blasting experience. The eighth person was this writer. One additional person from OO-ALC/MMSRA, assisted in the operation by moving hoses and helping the blasters in general.

AIRCRAFT SELECTION

The aircraft selected by OO-ALC/MMSRA was scheduled to be transferred to the St. Louis ANG (where the first blasted aircraft is now located). F-4E Serial Number 68-0448 had the original koropon epoxy undercoat and had 11 coats of top-coat paint consisting of epoxy, lacquer, acrylic and polyurethane types of paint. This was the first stripping action for this aircraft since the original paint job in 1968. The paint was peeling, flaking and chaulking and the top four coats had been oversprayed in the field without the application of primer between the topcoats. This was a prime example of the type and condition of the paint systems existing in the field. It was a very difficult aircraft to strip because of the koropon epoxy primer.

AIRCRAFT PREPARATION

The aircraft was delivered directly to Building 223 from the disassembly operation. In order to eliminate the possibility of water contamination in the blast booth, it was not washed before stripping. The major components were removed and forwarded to the cleaning facility (Bldg 220) for washing prior to routing for blast stripping. The aircraft was placed on four jacks with a jack and keel adaptor under the keel. Pole jacks were used to hold the aux-air doors in the up position. The aircraft was raised to a nominal height of six foot six inches to the underside of the wing. The landing gear was not retracted and the speed brakes were removed because the DMM requested that the landing gear wells and the speed brake wells be stripped as part of the exterior of the aircraft. The canopy and all major access holes were sealed with the special plugs/covers designed for that purpose. 3M555 blasting tape was used to protect all areas where special plugs were not practical, and to cover the formation light lens. All drain holes were plugged with "wood golf tees" or plastic cap plugs as required. The radome and the aft access to the engine bays were covered with barrier paper with 3M blasting tape and duct tape. The canopies were opened and the cockpit area was draped with plastic film held in place with duct tape.

PERSONNEL PROTECTION EQUIPMENT

All personnel performing the blasting operation wore ear plugs, paper coveralls, work gloves and breathing air hoods. Personnel not involved with the blasting operation wore paper coveralls, paper hoods, goggles and dust masks. Visitors were required to view the operation from the observation

booth. After lunch, the blast personnel were issued cloth coveralls because the paper coveralls were getting ragged as a result of the plastic bounceback off the aircraft surface.

BLASTING OPERATION

The blasting operation, as defined in the attached AFLO 959 (Atch #1) Work Control Document, was followed for the paint removal process. The two hoses on the right side of the blast booth (numbers 1 and 2) were regulated at 40 PSI nozzle pressure, as well as hose #3 which was used to blast the belly. Hoses numbers 4 and 5 were set at 30 PSI. This pressure was maintained throughout the blasting process. The difference in the removal rates was noted when the personnel stopped for lunch. The upper right side of the aircraft was completely stripped while the left side had a portion of the fuselage and the wing which were still covered with paint (approximately 25 square feet). Approximately two thirds of the belly was stripped. The operation had started at 0815 with the lunch break starting at 1045 hours. The reason for the early lunch break was a problem associated with the installed classifier vibrators which required 90 PSI air for operation, but due to the use of the fifth hose, were only received 40 PSI and therefore not operating correctly. This unforeseen malfunction of the vibrators caused an overload condition within the classifier which caused the rotary valves to jam with plastic media and caused the recovery system to become inoperable. The classifier was manually unloaded and the plastic media was transferred directly into the hoppers without being cleaned. This uncleaned plastic media cause a dusty condition during the blasting operation. This emergency media transfer operation was repeated throughout the blasting period (until 1515 hours) when the aircraft was completed. It was discovered that the problem was caused by a lack in communication with the painting personnel in the adjoining building (Bldg 220) as follows: A backup air supply is connected to the blast booth from Building 220 to provide air supply in the event that a malfunction existed with the blast booth compressor. This backup air system became operable with the use of the fifth blast hose and caused an air pressure drop in the air supply for aircraft painting. When this happened, the painting personnel did not have enough air pressure for painting and shut off the innerconnect air to the blast booth. The result was the drop in air pressure as described above. The obvious solution is to operate the blast booth with four hoses the way it was originally designed and maintain the fifth hose as a system backup. Even with this major problem, the aircraft was stripped in a total of 25.4 man hours or less than one flow shift. An additional problem was noted with the recovery system in the blast booth floor. It was discovered that the paint was coming off the aircraft in large flakes due to the lack of primer between coats. These flakes were sliding between the floor trash screens and the guides and closing the media recovery access holes. The last problem identified with the booth was the turbulent air flow caused by the blast hoses disturbing the down-draft air flow, and the dust clinging to the walls.

PROBLEMS - DEFICIENCIES - FINDINGS - RECOMMENDATION

The untrained personnel again proved that an actual aircraft blast operation was not the place to learn the process. These people blasted on the fiberglass antennas too long and caused irreparable damage. They also damaged the formation lights (fiberglass) and they took longer to remove the paint

from the same surfaces as the experienced blasters. A precision plastic blaster must be familiar with the aircraft and the varied surfaces before actual blasting is allowed.

The only problem associated with the blast equipment was an obstruction in the number 2 hose nozzle. This was a result of the last-minute modifications to the storage hopper. A special trash screen will be installed over the outlet of both rotary valves to prevent reoccurrences of this problem.

The difference in paint removal rates between the 30 and 40 PSI settings proved that all of the machines should be operated at 40 PSI. The lower pressure also made it necessary to get closer to the surface to remove paint. In many cases, this was not practical because of the stand-off distances that were required in specific areas which could not be reached without providing additional maintenance stands.

In general, the mechanical plugs were satisfactory. Several of the plugs were not installed correctly due to inexperienced personnel. Some of the plugs were not necessary because we found that by removing an access plate, we could clean the area quicker than it took to plug the access holes into that area. We also found that most of the areas that gave us problems were areas in which the access covers were removed during normal PDM. The next test aircraft will have special procedures written to remove these access covers during the disassembly operation and have them temporarily replaced with four screws/bolts to provide easy access for the post cleaning operation. Additional covers are being fabricated to protect areas which were draped with barrier paper and some of the plugs are being modified so that they work more efficiently. The plus on this one is that all of the cavities under these access plates would be washed with soap and water as part of the final wash operation, making the aircraft cleaner and eliminating the use of much of the 1.1.1 Trichloroethane during the PDM cleaning process.

The "Blastmobile", the unit which was designed to provide the right altitude for blasting the belly of the aircraft - with wheels so that the person blasting could move about with ease, was a basic failure. The "Colt" reclining automotive seat was the right distance from the surface to be blasted with the reclining adjustment made it perfect for the job but that is where the good parts end. The unit was too long, the swivel wheel in the front would not turn, the non-swivel wheels in the back were a mistake, and the person using the unit (myself) spent more time dragging it sideways than it was worth. A complete design change has been suggested which should make it totally usable for the next test aircraft. The major design changes suggested is the installation of special non-directional ball wheels and shortening the front extension.

The Validation & Verification (V&V) of the facility had to be postponed and will be performed during the next test aircraft because of the problems associated with air, recovery, and classification of the booth. These major changes and additions should make the facility meet the requirements as specified in the Statement of Work (SOW). In addition, a fund citation has been provided to add a staging area (cover) for small parts directly south of the small parts receiving door. This will allow an area large enough for drying and general decontaminating parts prior to blasting so that water and snow is not brought into the facility during inclement weather.

The cursory time study performed by the Engineering Time and Motion people is Attachment 3 to this report. This study is provided to show what can be done with the use of five hoses with one half inch nozzles and enough people to perform a continuous blasting operation - and having enough standby people to disregard breaks and rest time for operating personnel. The major intent of this test was to check the facility output to the maximum on a continuous run basis, not to establish a speed run. These times will not be used as the official time until a total of five F-4 aircraft have been stripped and timed. The average of these five operations will be used for the final Engineered Time Standard. The CYBER document will not be changed until this has been accomplished. Additional time was expended after the washing operation which is not listed on the time study because it was categorized as "inspection time/post cleaning". The present proposal is to establish a "Post Cleaning Operation" after the blasting has been completed to remove the access covers and blow the plastic media out of the cavities prior to the washing operation. The first run at this proved to be very successful with a comparison between this aircraft and the first prototype. The amount of plastic found in this second prototype was less than a tenth of what was left in the first aircraft.

We did discover that a "Hose Handler" person is required to provide help, aide and assistance to the blasting personnel in handling the awkward and heavy blast hoses, especially when the blast operator is working the top of the fuselage and trying to drag the blast hose at the same time.

There should be an increase in the blasting time for the next aircraft because of the reduction to four hoses, the inclusion of the hose handler, and performing the operation at a nominal rate; (allowing breaks, etc) at the same time, with the removal of the access plates, we expect to see a reduction in the cleaning time. The overall time, therefore should be somewhat the same. We still believe that it will be possible to plug and blast strip an aircraft the size of the F-4 in one shift and perform the post cleaning and washing operation the second shift, maintaining the original estimates of producing a complete aircraft in one flow day.

The barrier paper and blast tape on the aft engine bay doors will be replaced with the manufacture of a set of metal plugs. Metal covers (6) will be used to cover the formation lights instead of using blast tape which is a time consuming operation and does not provide the necessary edge protection.

The air problem with the vibrators will be solved by rerouting the air lines and providing dedicated air to the vibrators. The vibrators have also been increased in size and capacity to operate at their designed mid-range instead of a continuous maximum output.

The problem associated with the recovery floor trash screens has been solved with the installation of a new trash screen with a six inch overlap between each screen. This will prevent entry of the paint chips because it has sealed all of the access holes.

Several access plates (101, 102, 103 for example) will be removed during the disassembly operation, and reinstalled with a minimum number of screws. These plates will be removed during the post cleaning operation to remove

the ingress of plastic media in areas which cannot be sealed. These same areas will be washed with soap and hot water during the washing operation. Each of these areas will be identified in a 959 Work Control Document for the disassembly operation for the next test aircraft.

Several anti-static compounds have been tried on the walls along with different types of wax. To date, it appears that the new "Turtle Clear Wax" does the best job in keeping the dust from sticking on the walls. A blow-down operation will be identified after each aircraft stripped in the blast booth to prevent dust buildup. The wax on the walls makes it easier to remove the dust with an air nozzle. This problem will be worked throughout the five aircraft test program until it is solved.

Special air diverters are being installed to help solve the air flow problem. An additional axial flow fan will be used to bring fresh air into the booth and to increase the air flow to remove airborne dust. When the air flow problem is solved, BIO will be requested to make a flow study to verify that the booth meets the OSHA/AFOSH requirements for air flow for this type of blast operation.

In accordance with the Bureau of Mines explosibility study of 20 March 1985, the study specified that a 64 mesh screen be used to remove the fines which were within the explosive index. In order to exceed this requirement, the classifier has been equipped with a 50 mesh screen for plastic media/dust separation.

The 3M555 blast tape proved to be ineffective for providing the edge protection required for fiberglass. 3M has responded with a new blast tape product which has a better adhesive and has a thicker core. The new material will be used on the next test aircraft.

During the blast operation, the untrained personnel destroyed several of the radome antennas due to over blasting. All of the antennas will be protected with blast tape on the next test aircraft and blasted with the whip hose and small nozzle after the aircraft has been completed. This should eliminate this problem.

The wood golf tees and plastic plugs were not as successful as anticipated. The blast effect eroded and weakened the golf tees to the extent where they were easily broken during removal. The plastic cap plugs flange area eroded off which made them very difficult to remove. The next test will use plastic golf tees and the cap plugs will be filled with sealant and allowed to cure before use.

The fiberglass canopy covers worked very well. The cockpit was draped with plastic sheeting which kept the plastic out of the cockpit. The only ingress problem was through the canopy hinge areas. These areas will be sealed on the next aircraft with RTV sealant.

The aluminum maintenance stands designed and fabricated for the blast operation, provided access to all upper areas of the aircraft except the painted area above the aft fuselage section. A possible solution is the installation of a step platform within the stand in this area. Design action will be initiated.

SUMMARY

The production of the second F-4 prototype proved that the blast booth and associated equipment is capable of stripping a complete aircraft in a single shift, and that the basic design of the recovery and classification systems will meet the requirements of the Statement of Work. The Work Control Document (AFLC Form 959) has been improved with each test blasting of an aircraft and will soon be ready for submittal to OO-ALC/MMSRA for inclusion to TO 1F-4C-3-1-6. The booth will be turned over to the production facility as soon as the final test aircraft is completed and the blast booth is verified as a safe facility by the Fire Dept (DEF), Safety (SEG) and Bio-Med (SGB).

AMENDMENT TO ATTACHED INTERIM REPORT ON BLAST STRIPPING SECOND F-4 AIRCRAFT


1. ON 5 JUNE 1985, THE THIRD F-4 AIRCRAFT WAS BLAST STRIPPED. THIS WAS F-4G SERIAL NUMBER 69-7587, THE FIRST F-4G FROM USAF, BY DIRECT REQUEST FROM THE USAF COMMANDER, GENERAL CURTIS.

2. USING INFORMATION GAINED FROM THE SECOND AIRCRAFT, ACCESS PLATES, DOORS AND CONTROL SURFACES WHICH CONTAINED LARGE AMOUNTS OF BLAST MEDIA AFTER THAT BLAST STRIPPING OPERATION, WERE REMOVED ON THIS AIRCRAFT PRIOR TO THE BLASTING PROCESS. THIS PROVED TO BE VERY SUCCESSFUL BECAUSE IT PROVIDED ACCESS TO ALL OF THE PROBLEM AREAS AND MADE IT EASY TO CLEAN THE CONTROL SURFACES (AILERONS, FLAPS AND RUDDER) AFTER THEY WERE STRIPPED. THE TOTAL BLASTING OPERATION, INCLUDING THE COMPONENT PARTS, TOOK APPROXIMATELY 25 HOURS TO REMOVE ALL OF THE PAINT. AN ADDITIONAL SHIFT, USING 3 PEOPLE WAS ALLOWED TO PLUG AND SEAL THE AIRCRAFT, AND ANOTHER SHIFT WAS ALLOWED TO BLOW DOWN THE ENTRAPPED PLASTIC MEDIA AND PERFORM THE SOAP WASHING OPERATION. IT WAS THE CONSENSUS OF THE PEOPLE PERFORMING THE TASK THAT THESE TIMES WOULD IMPROVE WITH THE TRAINING CURVE.

3. WITH THE RECEIPT OF THE HQ-AFLC APPROVAL TO PLASTIC BLAST STRIP ALL F-4 AIRCRAFT AT THE DEPOT, CO-ALC/MMSRA IS IN THE PROCESS OF PROVIDING THE NECESSARY TECH DATA TO MEET THE FACILITY TURN-OVER SO THAT THE AIRCRAFT DIVISION CAN START PRODUCTION BLASTING IMMEDIATELY AFTER THE BLAST BOOTH HAS BEEN TRANSFERRED TO THE AIRCRAFT DIVISION. THE "CYBER" DOCUMENTS WILL CONTAIN A COMPLETE DETAILED PROCEDURE FOR ALL MDS F-4 AIRCRAFT.

4. SEV AL MODIFICATIONS HAVE BEEN ACCOMPLISHED ON THE BLAST BOOTH TO IMPROVE OR ELIMINATE THE PROBLEMS OUTLINED IN THE SECOND INTERIM REPORT DOCUMENT. THE RECOVERY SYSTEM HAS BEEN EXPANDED AND AN ADDITIONAL DUST ELIMINATION SYSTEM HAS BEEN INSTALLED. IN-PROCESS TESTS HAVE INDICATED THAT THE SYSTEM WILL MEET THE REQUIREMENTS OF THE STATEMENT OF WORK. THE FINAL TEST ON THE RF-4 SHOULD VALIDATE THE OPERATIONAL PARAMETERS OF THE BLAST BOOTH.

5. A FINAL REPORT WILL BE INITIATED AFTER COMPLETION OF THE RF AIRCRAFT TO PROVIDE ALL INTERESTED PERSONS WITH ENOUGH DETAILED INFORMATION TO START THE PLASTIC MATERIAL BLASTING OPERATION AT THEIR OWN FACILITIES. POINT OF CONTACT FOR COPIES OF THIS REPORT WILL BE CO-ALC/MABEB, HILL AFB, UT 84056-5149. AUTO-VON 458-3534/BOB ROBERTS.

	CO-ALC/MABEB
	Hill Air Force Base, Utah 84056
Robert A. Roberts	
Program Manager Plastic Bead Blasting	
AV-458-2042 801-777-3534	

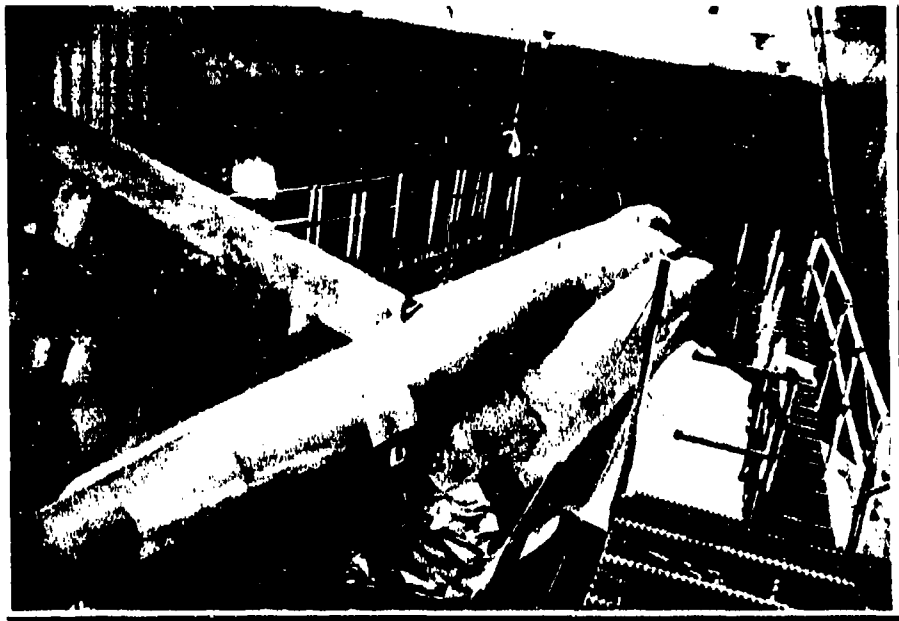


Figure 4-1 F-4 aircraft plastic media stripping completed. The anodized aluminum looks new. The aircraft paint included original primer coats.

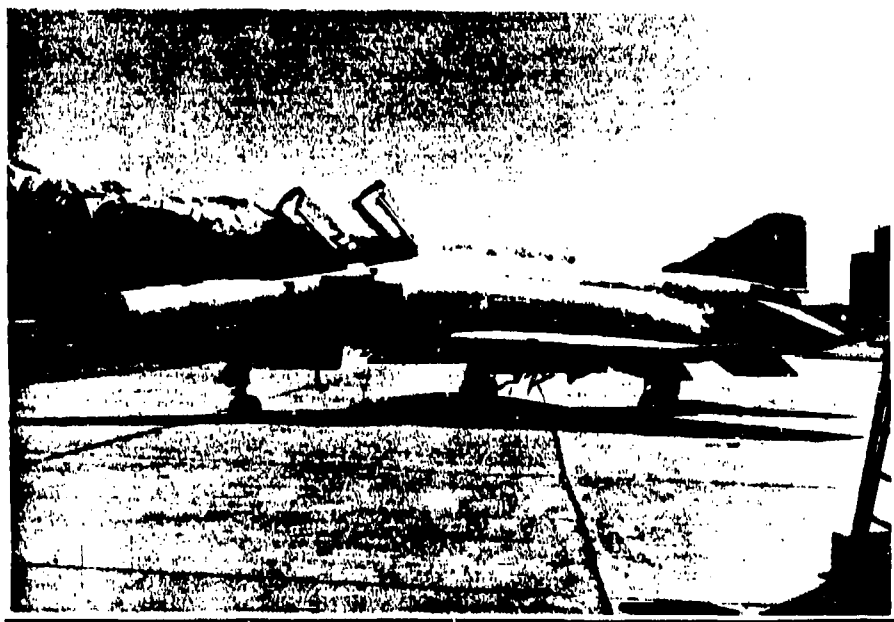


Figure 4-2. F-4 aircraft stripped by conventional solvent methods. Note the difference in surface appearance. The shiny aluminum indicates the anodized aluminum surface was damaged when paint was scraped off. Also note the brownish areas where the paint remains. This aircraft will be re-taped and stripped again.

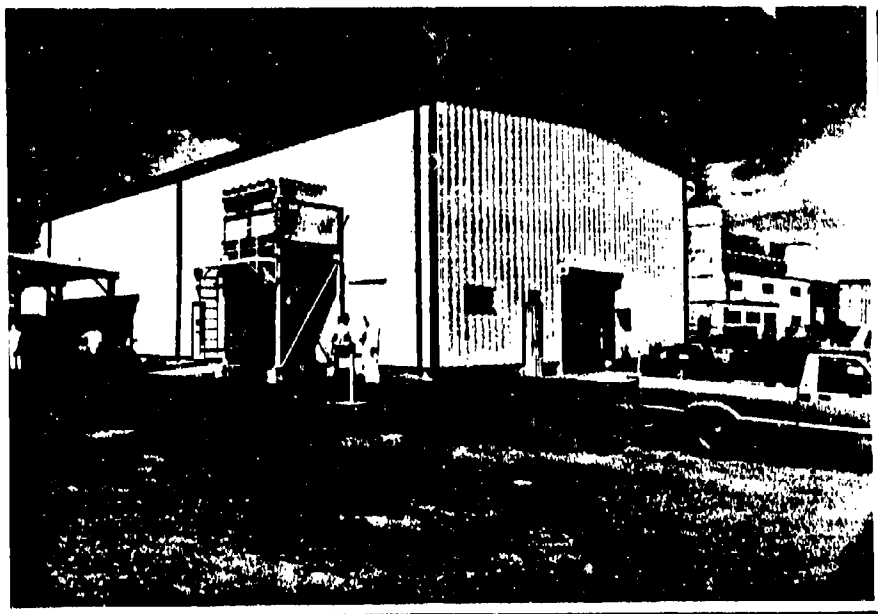


Figure 4-3. Building 223 Hill AFB PRAM plastic media paint stripping facility. On the left is one of two air ventilation dust collectors. The rollup door provides access to the mechanical equipment room. The main access door is located at the opposite end of the facility.

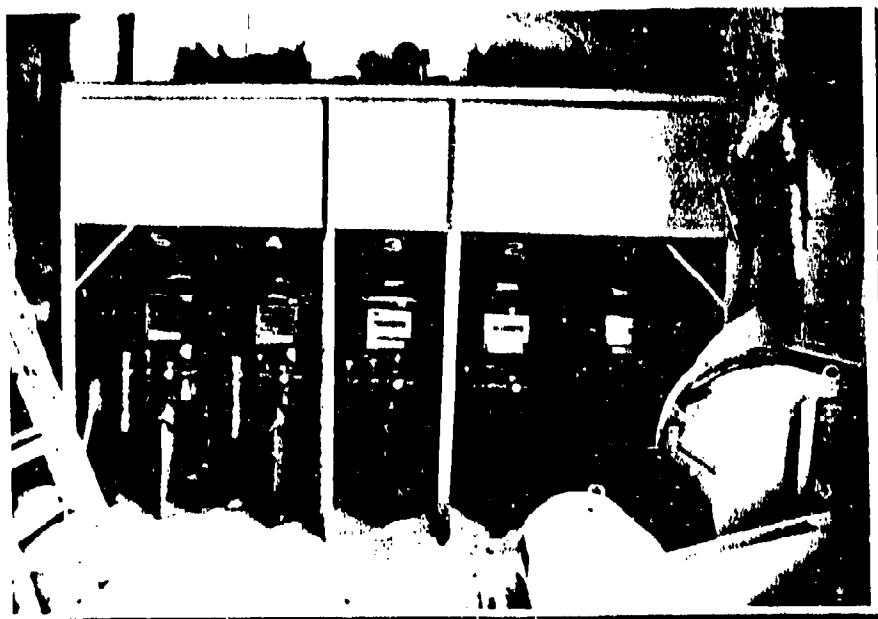


Figure 4-4. Equipment Room. Plastic media storage hoppers mounted above Paulli and Griffin blasting machines.



Figure 4-5. Plastic media stripping of F-4 aircraft (floor level view).

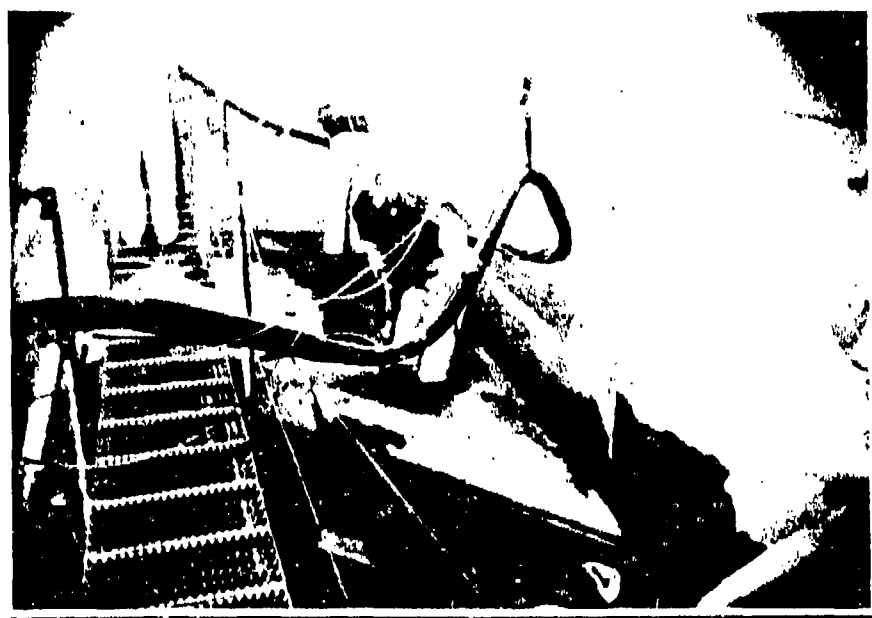


Figure 4-6. Plastic media stripping of F-4 aircraft (viewed from above).

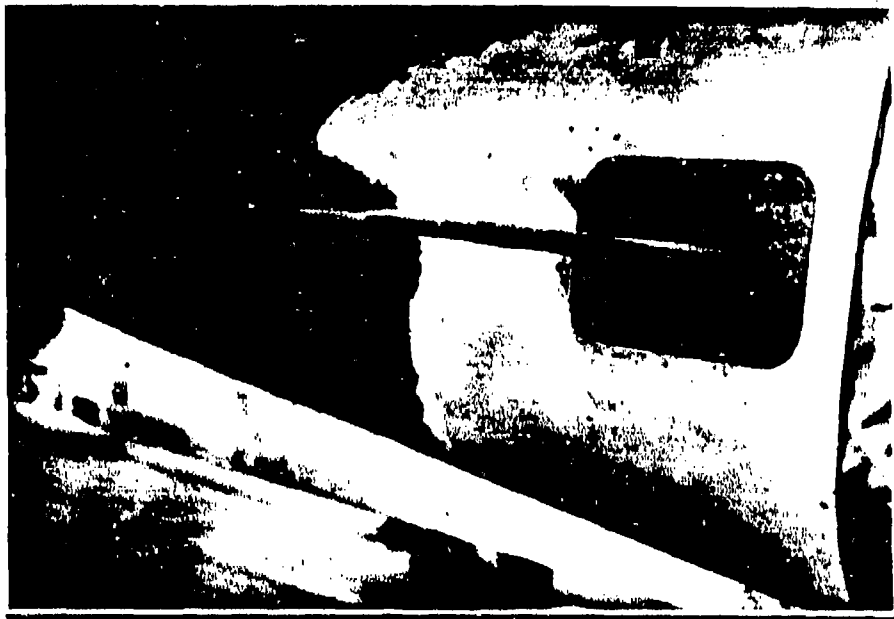


Figure 4-7. Plastic media stripping peels the paint from the anodized aluminum surface without damage to the surface.

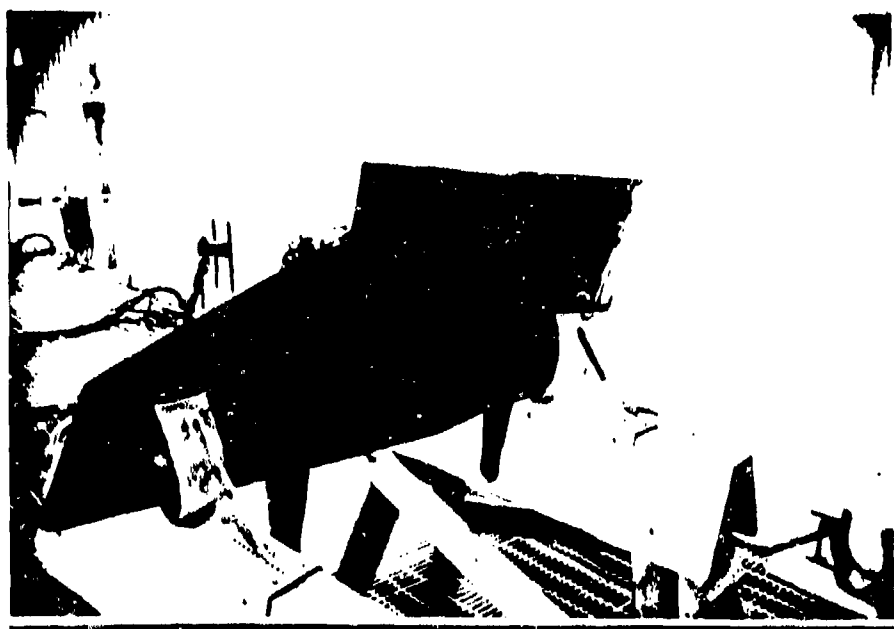


Figure 4-8. F-4 aircraft component mounted for stripping. Stripping right edge started.

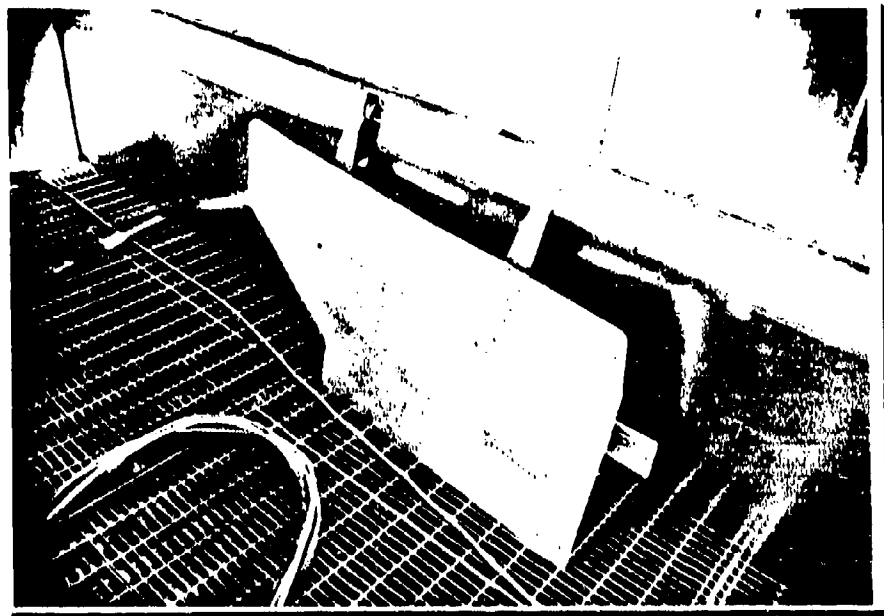


Figure 4-9. F-4 aircraft component stripping completed.

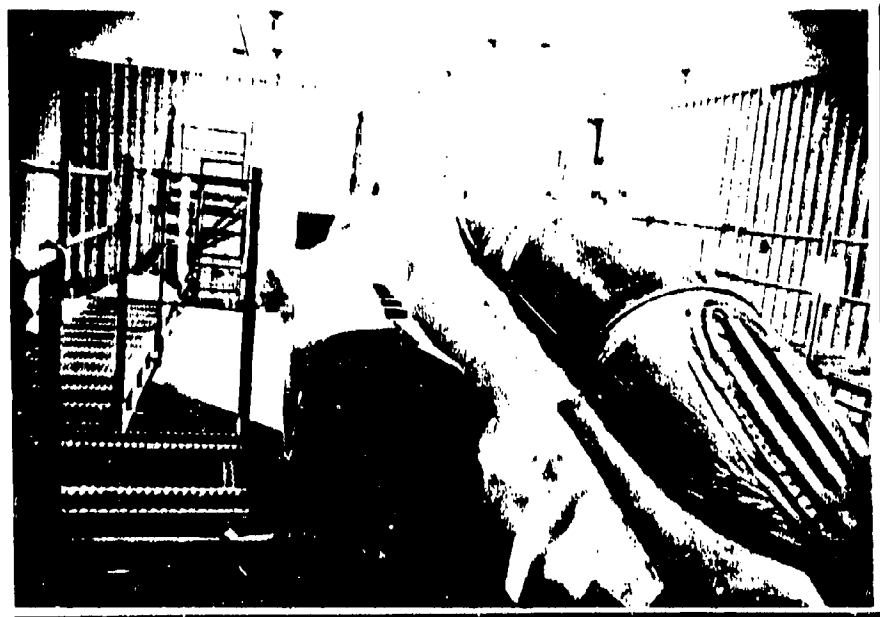


Figure 4-10. F-4 aircraft plastic media stripping completed. First full-scale test of system required five workers approximately 4 online hours to completely strip the aircraft.

P L A S T I C M A T E R I A L B L A S T I N G

STRIPPING PAINT FROM THE THIRD F-4 AIRCRAFT, THE FIRST RF SERIES

AT HILL AIR FORCE BASE, UT

3 JULY 1985

PREPARED AND SUBMITTED ON 17 JULY 1985
BY

ROBERT A. ROBERTS
OO-ALC/MABEB
HILL AIR FORCE BASE, UTAH
84056-5149

AUTOVON 458-3534/2042
COMMERCIAL (801) 777-3534

NOTE:

THE REMOVAL OF PAINT FROM THE FINAL F-4 PROTOTYPE IS PART OF THE THIRD AND FINAL STAGE OF THE "PRODUCTIVITY-RELIABILITY-AVAILABILITY-MAINTAINABILITY (PRAM) PROJECT NUMBER 00-143.

Test Report:

TITLE:

Paint Removal from RF-4 Aircraft Using the Plastic Material Blasting (PMB) process.

AIRCRAFT PROCESSED:

RF-4 Serial Number 64-1069

PURPOSE:

The purpose of this test was to verify the PMB process in the newly constructed PMB blast booth designed specifically for this procedure:

- a. To determine the adequacy of the modified equipment.
- b. To determine the adequacy and fit of the special plugs required to prevent ingress of the plastic media, and to protect special camera windows.
- c. To verify the use of the modified "Blastmobile" with the modified swivel wheels.
- d. To validate and verify the blast booth.

FACILITY:

The new blast booth, identified as Building 223 is now in the third modification/change for air flow and dust control. Special exhaust vents were installed in the ceiling (6 places) to create an air flow for dust control. This modification was not as successful as desired and did not control the eddy currents and air flow patterns within the blast booth.

EQUIPMENT:

The low-pressure air flow system was not in operation for this test. A phasing problem generated in the wiring to the motor, and the motor burned out. The contractor attempted to change the motor, but was unable to procure a replacement unit with the same base mounting features. The entire aircraft was therefore blasted without the use of the dust control or low pressure air flow system. The special vents which were installed in the major air recovery system was classified as a success. The next test operation will verify the use of both of these systems working together to provide a basic dust-free working area within the blast booth.

The Blastmobile did not work as expected. The tread on the four swivel wheels was not wide enough to operate as required over the floor grate. The blastmobile is now undergoing a modification which will provide a special non-directional ball wheel which will satisfy the requirement. This will be tested during the next test phase.

Number five blast pot did not operate due to a malfunction in the "spear valve" area. It was found that the valve was not seating correctly and therefore was not providing an air-tight seal during operation. Action is being taken to correct this seating problem with the pot manufacturer.

The air compressor stopped operating during the last four hours of the test. This was caused by an excessive build-up of dust on the compressor filter which had occurred before the new compressor air inlet had been installed within the compressor room. A standard cleaning operation on a daily basis will prevent this from happening again. (lesson learned!)

MATERIAL:

The use rate of the plastic blasting material has not been determined to date. After blasting a 6 x 6 truck for the Air National Guard in Salt Lake City, (in 45 minutes), all of the components parts from 64-1069 and the complete aircraft, the main hopper was half full. This was the highest use rate to date with no concrete explanation. The next test will be made with the blast media in the 20/40 mesh size in the "Special Mix" category. The plastic manufacture has compounded this special mixture at the request of Republic Air Lines, as a result of a test performed at their facility which showed an extended life cycle of the blast media.

PERSONNEL:

Four personnel were used for this test. Three of these were trained in complete aircraft blasting, the fourth had been trained in component blasting. A fifth person was used in the blast booth as a "hose handler" and general assistant to the blasters. An additional person was assigned to the equipment room to keep the equipment operating correctly. This will be the minimum number of people required to perform all blast operations in the future.

AIRCRAFT PREPARATION:

The same plates were removed from this aircraft during the "disassembly" stage as were removed from the last aircraft tested. These are the same plates which will be identified in the Tech Order, (IF-4C-3-1-6), as a standard operation. Again, RTV sealant was used around the cracks in the canopy, the RAT door and the Flare doors. This did not work as well as before and allowed plastic media to get into most areas (except the cockpit) we were trying to protect. The next protective measure will be the use of duct cloth tape cut to one half inch width, which will make it necessary to clean the paint manually from these one half inch areas. A new blast tape, manufactured by the LARMART Corporation, was tried and proved to be very successful because the gum on the tape was stronger than any other type tested to date. Further tests will be made with this product in the attempt to find a blasting tape which will perform to the total requirements.

PERSONNEL PROTECTION EQUIPMENT:

Two of the blast personnel wore the standard 3M Blast Hood for this operation. This hood has a 120 degree viewing area and is easier to see than the Bullard 999 Series hood provided with the blast booth. More of these units are on order to provide blast personnel with a choice of protective equipment.

BLASTING OPERATION:

The aft section of the engine bays doors was blasted first - this is the area on the aircraft which contains titanium. A small amount of low-order sparking was observed during this operation. With relatively no dust in the blast booth, the chance for explosive sparking was non-existent. This total operation was performed for the benefit of the visiting personnel, therefore the blasting was stopped every hours so that progressive photographs could be taken of the operation. After four hours, 80 percent of the aircraft was stripped, and then

the air compressor started to cur out. The aircraft was completed the following Monday (8 July 1985) with a total blasting time of 21 hours. Lesson learned is not to start a job like this before a four-day holiday and expect to get it done on time! This lack in continuity also created problems in the cleaning area. The aircraft was washed on "Graveyard" shift by personnel who were not familiar with the additional problems associated with a blasted aircraft. As a result, several of the doors which should have been removed were left in place, resulting in a lot of plastic media being left in the aircraft when it was delivered to the PDM lines.

PROBLEMS - DEFICIENCIES - FINDINGS - RECOMMENDATIONS:

Using better trained people was an asset to the operation. However, we used all of our trained people on day shift and did not have anyone to follow the operation on swing shift. If the personnel had been available, the aircraft could easily have been completed during the second shift (after the screen on the compressor had been identified and cleaned). The aircraft would have been ready for the cavity opening operation the third day and would have been thoroughly cleaned before it had been delivered to the PDM lines.

The installation of the fifth blast machine/hose proved to be a wise decision. With number 5 machine out of operation, the programmed function was accomplished with the installed equipment and still meet the estimated aircraft stripping rates.

The cockpit sealing operation, using the RTV sealant material, worked very well. The advantage of this material is that it cures on the outside and the inside remains soft after a day of curing - thus making it easy to remove after the blasting is completed. When the material is allowed to remain on the surface for four days, as was the case with this aircraft, removal of the cured RTV is extremely difficult. Lesson learned is that planning and programming is very important.

The Validation and Verification of the facility had to be postponed again because of the low-pressure motor problem. The total change to the air flow system being accomplished as a result of this last failure should eliminate all of the air flow/dust flow problems. This will be accomplished with the next test blasting with an F-102 Aircraft from the HAFB Heritage Foundation. The scheduled completion date for the blast booth is still 31 July 1985.

All of the problems associated with plugging vent and drain holes is still in an on-going test stage and will continue until the minor problems are solved.

SUMMARY:

This test proved again that the blasting operation is the next state of the art method for aircraft paint stripping. The complete operation is still in the 30 hour category and it will improve with time. The "Pre-Final" inspection was performed in the blast booth with 25 line items to be worked out before contract sign-off. These items are in the final stage of completion and it looks like the contractor will meet the 31 July 1985 completion date.

NOTE: The booth fire suppression system (Tharmatic Halon 1211) will be upgraded to meet the National Fire Code and the complete system will be tested to see if it will pass the fire code requirements. If this does not work, a water sprinkler system will be installed along with the halon system.

5.0 PRODUCTION BENEFITS

Memorandum for the Record: R.W. Boubel to P.S. Daley, Evaluation of Dry Vs. Wet Paint Stripping, August 1, 1984.

Table 5.1 Plastic Bead Blasting Results

Table 5.2 F-4 Direct Cost Comparison (Projected), Chemical Vs. Drystrip

Table 5.3 AFLC Form 117, Economic Evaluation of the PRAM F-4 Blast Booth Project

Transcript of Videotape, Plastic Blasting Versus Chemical Paint Removal

5.0 PRODUCTION BENEFITS

The following page contains an economic justification for converting all DoD facilities from wet chemical paint stripping to dry media paint stripping.

Tables 5.1 and 5.2 summarize production and other benefits identified during initial prototype testing of plastic bead blasting prior to construction of the F-4 blast booth. Initial results for the F-4 facility are presented in Sections 2 and 4. A comprehensive report on the PRAM project will be completed when the facility is turned over from development to production. AFLC Form 177 (Table 5.3) is an economic evaluation of the PRAM project.

Two videotapes which compare plastic media paint stripping to conventional chemical stripping are available. The first videotape was prepared by DoD personnel to show initial results with plastic media paint stripping at Ogden Air Logistics Center and North Island Naval Air Rework Facility. The second videotape was prepared by the supplier of the plastic media, U.S. Technology Corporation, from the first videotape. Neither include the new F-4 facility. Both videotapes were shown during the workshop. A transcript of the second videotape is given in the remainder of this section to illustrate the production and environmental benefits of converting a paint stripping operation from chemicals to plastic media.

August 1, 1984

MEMORANDUM FOR THE RECORD

TO: Peter S. Daley

FROM: R. W. Boubel

SUBJECT: Evaluation of Dry vs Wet Paint Stripping as per your request of August 1, 1984

ECONOMIC JUSTIFICATION OF CONVERTING ALL DOD FACILITIES FROM WET CHEMICAL PAINT STRIPPING TO DRY MEDIA PAINT STRIPPING.

COST ESTIMATES

ITEM	WET PROCESS	DRY PROCESS
MANHOURS	3,360,000	1,426,000
CHEMICAL PAINT STRIPPER	7,000,000 GAL	- 0 -
WASH WATER	100,000,000 GAL	- 0 -
DRY WASTE	- 0 -	500,000 LB
OPERATING COSTS		
MANHOURS	\$136,516,800	\$67,698,380
SUPPLIES	30,960,000	4,400,000
WASTE TREATMENT COSTS	8,000,000	1,500,000
TOTAL OPERATING COSTS	\$175,476,800	\$73,598,380
OPERATING COSTS SAVINGS (WET - DRY)	\$101,878,420	

Table 5.1

PLASTIC BEAD BLASTING RESULTS

(All figures based on initial prototype testing. Final figures will almost certainly vary.)

E C O N O M I C S

MANPOWER	1/10th AVERAGE TIME REQUIRED BY CHEMICALS
HAZARDS	ELIMINATION OF CHEMICAL HAZARDS TO WORKERS
MATERIAL	\$585K vs \$24K FOR SAME AMOUNT OF WORK
ENERGY	ONE HALF OF PRESENT EXPENDED (SAVE \$300K)
POLLUTION	ELIMINATION OF SEWAGE CONTAMINANTS (\$22K)
PRODUCTION	INCREASE CAPABILITY BY 100% ON F-4 STRIPPING
UTILITIES	SAVE 20K GALLONS OF WATER PER AIRCRAFT
CAPABILITY	SYSTEM CAN STRIP MOST SURFACES (INCLUDING COMPOSITES WITHOUT DAMAGE TO SUBSTRATES)

P R O D U C T I O N C O M P A R I S O N S

END ITEM	CHEMICAL TIME	BLASTING TIME	SAVINGS
RUDDER	3 HR 36 MIN	15.6 MIN	\$27.9K
INBD L/E FLAP	2 HR 48 MIN	21.6 MIN	19.7K
SPOILER	40 MIN	14.4 MIN	4.3K
OUTBD L/E FLAP	2 HR 48 MIN	18.6 MIN	20.1K
AILERON	6 HR 28 MIN	32.4 MIN	97.2K
WINGFOLD	8 HR 45 MIN	54.1 MIN	131.5K
STABILATOR	9 HR 49 MIN	55.2 MIN	74.7K
		TOTAL SAVINGS	\$375.8K/year
PROTOTYPES			
P-8 PUMPER TRUCK	52 HRS	5 HRS	
COLEMAN TRACTOR	40 HRS	4 HRS	
F-100 AIRCRAFT	300 HRS	37 HRS	
F-4 AIRCRAFT	341 HRS	39 HRS	

Table 5.2

F-4 DIRECT COST COMPARISON (PROJECTED)

CHEMICAL VS DRYSTRIP

	<u>CHEMICAL</u>	<u>DRYSTRIP</u>
CLEANING MAN HRS.	341	39
LABOR RATE	\$40.00/hr.	\$40.00/hr.
TOTAL LABOR COST PER AIRCRAFT	\$13,640	\$1,560
LABOR COST/SQ. FT. (2069 Sq. Ft.)	\$6.59/Sq. Ft.	\$0.75/Sq. Ft.
MATERIAL CONSUMPTION PER AIRCRAFT	\$2,460 (400 gal @ \$6.15/gal)	\$308.00 (140 lbs @ \$2.20/lb)
MATERIAL COST/SQ. FT. (2069 Sq Ft)	\$1.19/Sq. Ft.	\$0.15/Sq. Ft.
WATER TREATMENT COSTS @ \$9.71/1,000 gal (no phenols)	\$194.20 (20,000 gal/aircraft)	0
WASTE DISPOSAL COSTS @ \$100/dr. (secured landfill)	0	\$200.00
ENERGY COSTS (hanger ventilation)	\$1,719 (72 hrs floor time) (400 hp. vent)	\$72.00 (8 hrs floor time) (150 hp. vent)
ENERGY COSTS (direct operating)	0	\$449.00 (4 nozzles (.5") @ 160 cfm/nozzle)
TOTAL COST	\$18,013.20	\$2,589.00

Table 5.3 AFLC Form 177, Economic Evaluation of the PRAM F-4 Blast Booth Project (1 of 6)

1. DATE 15 Mar 85	2. FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA		3. DEPARTMENT HABEB	4. INSTALLATION OO-ALC Hill AFB, UT 84056-5149
5. LINE ITEM NUMBER PRAM 00-143		6. LINE ITEM TITLE AIRCRAFT BLAST SYSTEM			

ECONOMIC EVALUATION - DOD INVESTMENTS

1. DESCRIPTION OF ITEM: A turn-key Industrial Blasting System for aircraft paint removal. The system will be specifically designed for use with plastic media for blast removal of paint from aircraft and ground support equipment.

2. PROJECT BENEFITS ABSTRACT: Proposed Blast Booth will reduce man hours, aircraft flow time, material cost, energy cost and will eliminate the generation of hazardous chemical waste.

SUMMARY OF EQUIPMENT COSTS		SUMMARY OF EQUIPMENT BENEFITS	
FORMAT A		FORMAT B	
1. INVESTMENT:		1. PERSONNEL:	
a. Acquisition Cost.	\$ 658,389.	a. Civilian	\$1,173,800.
b. Installation Cost.	0	b. Military	0
c. Design	0	c. Other	\$1,534,687.
d. Other Cost	0		\$219,241.
e. Total Cost	\$ 658,389.		\$ 1,315,446.
2. LESS TERMINAL (disposal) VALUE OF EXISTING EQUIPMENT:		2. OPERATING COSTS:	
	0	a. Maintenance	\$ 210,000.
		b. Utilities	480,665.
		c. Other	\$1,115,057.
			\$ 72,314.
3. NET INVESTMENT:		3. OVERHEAD:	
	\$ 658,389.		0
4. TOTAL PRESENT VALUE OF BENEFITS:		4. TOTAL ANNUAL SAVINGS:	
	\$25,172,270.		\$ 4,088,407.
5. SAVINGS/INVESTMENT RATIO:		4a. PRESENT VALUE OF ANNUAL SAVINGS:	
	38.23		\$25,121,503.
6. AMORTIZATION PERIOD:		5. ONE TIME SAVINGS:	
	.2		0
		5a. PRESENT VALUE OF ONE TIME SAVINGS:	
			0
		6. TERMINAL VALUE (disposal value) OF PROPOSED EQUIPMENT:	
			\$ 131,678.
		6a. PRESENT VALUE OF the TERMINAL VALUE (disposal) of the PROPOSED EQUIPMENT:	
			\$ 50,767.
		7. TOTAL PRESENT VALUE OF BENEFITS:	
			\$25,172,270.
		8. ECONOMIC LIFE:	
			10 YEARS
		9. DISCOUNT FACTORS: 10% TABLE A .38554 TABLE B 6.14457	

Page No. 1 of 6

1 DATE 15 MAY 85	2 FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA	3 DEPARTMENT HABEB	4 INSTALLATION OO-ALC HILL AFB, UT 84056-5149
5 LINE ITEM NUMBER PRAM 00-143	6 LINE ITEM TITLE AIRCRAFT BLAST SYSTEM			

ALTERNATIVES:

(1) PROPOSED ALTERNATIVE: Provide an Industrial Blasting System to accomplish this workload.

DISCUSSION: This is a feasible alternative and will be analyzed to determine costs involved.

(2) PRESENT ALTERNATIVE: Continue to remove paint from aircraft surfaces using chemical methods.

DISCUSSION: This method of removing paint from aircraft surfaces has worked in the past, however it is extremely time consuming. Very costly, hazardous to personnel and produces large amounts of hazardous waste.

(3) OTHER ALTERNATIVE: Use additional existing equipment available at Hill AFB to accomplish this workload.

DISCUSSION: There is no other equipment at Hill AFB available to accomplish this workload.

1 DATE 15 Mar 85	2 FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA		3 DEPARTMENT HABER	4 INSTALLATION 00-ALC H111 AFB, UT 84056-5149
5 LINE ITEM NUMBER PRAM 00-143		6 LINE ITEM TITLE AIRCRAFT BLAST SYSTEM			
EXPLANATION OF SOURCES/DERIVATION OF ESTIMATES					
<p>FORMAT B</p> <p>ITEM 1. Personnel:</p> <p>ITEM 1a. Civilian:</p> <p>1a1.Present: A review of time standards indicates that stripping paint from aircraft exterior surfaces requires 341 man hours. For FY-85 there are 209 aircraft programmed for depot repair. This workload is projected to remain steady. The direct labor rate for FY-85 is \$16.47 per man hour. 341 man hours X \$16.47 DLR X 209 aircraft = \$1,173,800. per year.</p> <p>1a2.Proposed: A time study has been conducted using the new plastic media blast system. The paint was stripped from the exterior of an F-4 aircraft in 39 man hours. 39 man hours X \$16.47 DLR X 209 aircraft = \$134,247. per year.</p> <p>1a3.Annual Savings: \$1,039,553.</p> <p>ITEM 1b. Military:</p> <p>1b1.Present: N/A</p> <p>1b2.Proposed: N/A</p> <p>1b3.Annual Savings: N/A</p> <p>ITEM 1c. Other: Flow Days</p> <p>Flow day cost calculations: Derived from USAF Cost and Planning Factors AFR 173-3. F-4 Utilization Rate = 0.68 hrs-day. F-4 Life Cycle Costs = \$1,086. per flying hour. Cost per flow day = 0.68 hrs-day X \$1,086.-hr = \$2,098.-flow day.</p> <p>1c1.Present: Using present methods requires 3.5 flow days per aircraft for chemical paint stripping. 3.5 flow days X 209 aircraft X \$2,098-flow day = \$1,534,607. per year.</p> <p>1c2.Proposed: Using the proposed method would reduce the required flow time to .5 flow days per aircraft. .5 flow days X 209 aircraft X \$2,098-flow day = \$219,241. per year.</p> <p>1c3.Annual Savings: \$1,315,446.</p>					
APLC FORM 177		3 of 6			

1 DATE 15 Mar 85	2 FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA		3 DEPARTMENT HABEB	4 INSTALLATION OO-ALC Hill AFB, UT 84056-5149
5 LINE ITEM NUMBER PRAM 00-143		6 LINE ITEM TITLE AIRCRAFT BLAST SYSTEM			

EXPLANATION OF SOURCES/DERIVATION OF ESTIMATES

FORMAT B

ITEM 2. Operating:

ITEM 2a. Maintenance:

2a1. Present: Sludge Removal: Using the present chemical type paint stripper, sludge is formed. This sludge must be removed from the pits and transported to a waste dump. The cost of this transportation is \$200. per ton. There is an average of 300K tons of sludge removed per year. Of this, 105K tons are generated as a result of the waste produced during chemical stripping.
105K tons X \$200 = \$210,000

2a2. Proposed: The proposed method does not produce sludge.

2a3. Annual Savings \$210,000.

NOTE: Present tests indicate that the dust produced as a result of the plastic blasting can be used as fuel for blower type furnaces. All that would be required is a precipitation device in the exhaust stack to collect the chrome. This could mean that the waste produced could become a fuel for producing steam.

ITEM 2b. Utilizations:

2b1. Present: The line of chemical stripper requires the use of large quantities of water. An average of 210K gal day is consumed in this operation. The cost of water is \$.43K gal.
210K gal-day X 22 work days=mo X 12 mo X \$.43K gal = \$23,839. per year.

2b2. Water Treatment: The water that is used requires water treatment. The cost of this treatment is \$8.24 per K gal.

210K gal X 22 work days=mo X 12 mo X \$8.24K gal = \$456,826.
TOTAL PRESENT = \$480,665. per year.

2. Proposed: The proposed method uses no water.

Annual Savings: \$480,665.

1 DATE 15 Mar 85	2 FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA	3 DEPARTMENT HABEB	4 INSTALLATION OO-ALC Hill AFB, UT 84056-5149
5 LINE ITEM NUMBER PRAM 00-143		6 LINE ITEM TITLE AIRCRAFT BLAST SYSTEM		

EXPLANATION OF SOURCES/DERIVATION OF ESTIMATES

FORMAT B

ITEM 2c. Other: Material

2c1. Present: The present method requires the use of chemical paint stripper. The paint stripper is used at a rate of 468 Gallons per aircraft. The cost of this stripper is \$11.40 per gallon. 468 gal-acft X \$11.40 per gal X 209 acft = \$1,115,057.

2c2. Proposed: The proposed method requires the use of plastic material. The facility design conserves the use of thin plastic media by separating the dust from the plastic and recovering the plastic for reuse. The amount of blast media which is lost during a single aircraft stripping operation is estimated to be 200 pounds per aircraft. The material cost \$1.73 per pound. 200 lbs per acft X \$1.73 X 209 acft = \$72,314. per year.

2c3. Annual Savings: \$1,042,743.

ITEM 3. OVERHEAD:

3a. Present: N/A

3b. Proposed: N/A

3c. Annual Savings: N/A

ITEM 4. TOTAL ANNUAL SAVINGS: (Total of Items 1, 2 and 3) = \$4,088,407.

ITEM 4a. PRESENT VALUE OF ANNUAL SAVINGS: (Item 4 X Item 9 Table b) \$4,088,407. X 6.14457 = \$25,121,503.

ITEM 5. ONE TIME SAVINGS: (Total of nonrecurring savings) = 0

ITEM 5a. PRESENT VALUE OF ONE TIME SAVINGS: (Item 5 X Item 9 table A) = 0

ITEM 6. TERMINAL VALUE: (disposal) OF PROPOSED EQUIPMENT (Acquisition cost X 202) \$658,389. X 202 = \$131,678.

ITEM 6a. PRESENT VALUE OF TERMINAL VALUE (disposal) OF PROPOSED EQUIPMENT: (Item 6 X Item 9 table A) \$131,677 X .38554 = \$50,767.

ITEM TOTAL PRESENT VALUE OF ANNUAL BENEFITS: Total of (4a, 5a & 6a) = \$25,172,270.

1 DATE 15 Mar 85	2 FISCAL YEAR FY-85	EQUIPMENT LINE ITEM DATA	3 DEPARTMENT HABEB	4 INSTALLATION OO-ALC Hill AFB, UT 84056-5149
5 LINE ITEM NUMBER PRAM 00-143	6 LINE ITEM TITLE AIRCRAFT PAINT SYSTEM			

EXPLANATION OF SOURCES/DRIVATION OF ESTIMATES

FORMAT A

ITEM 1. INVESTMENT:

ITEM 1a. Acquisition Cost: \$658,389.

ITEM 1b. Installation Cost: 0 (Included in above)

ITEM 1c. Design Cost: 0 (Included in above)

ITEM 1d. Other Cost: 0

ITEM 1e. Total Cost: \$658,389.

ITEM 2. Less terminal(disposal) value of existing equipment (10% of list price) = 0

ITEM 3. Net Investment: (item 1e less item 2 format A) = \$658,389.

ITEM 4. Present value of Benefits: (item 7 format B) = \$25,172,270.

ITEM 5. Savings/Investment Ratio: (item 4 divided by item 3 format A) \$25,172,270./\$658,389. = 38.23

ITEM 6. Amortization Period: (item 3 format A) (minus item 5 format B) Divided By (item 4 format B) \$658,389./\$4,088,407. = .16

SUMMARY: This project will increase the capability of Hill AFB to perform 100% of the programmed workload for stripping F-4 aircraft. The analysis shows that it will greatly reduce man hours, flow days, utilities and materials. The safety hazards ie.: Toxic fumes, and danger of skin burns from chemical paint strippers will be eliminated. The Environmental Protection Agency (EPA) guidelines on industrial wastes is being reduced to 4.57 mg-l. This project will enable us to meet these guidelines in the aircraft paint stripping unit. The annual savings produced by this project will enable it to be amortized in an extremely short time.

Transcript of Videotape
Plastic Blasting Versus Chemical Paint Removal

Source: U.S. Technology Corporation
328 Kennedy Drive
Putnam, Connecticut 06260
Phone (203) 928-2707

U.S. Plastic and Chemical Corporation introduces the plastic media dry stripping system, a revolutionary new technique designed and developed specifically for the aircraft maintenance industry. The U.S. system will enable the user to remove virtually all surface coatings and build-up from aircraft components, assemblies and bodies while greatly reducing if not completely eliminating the use of hazardous chemical cleaning agents. The U.S. dry stripping system will

- o eliminate most chemical pollutants
- o eliminate most air pollution
- o eliminate water contamination
- o reduce personnel exposure to chemical hazards
- o reduce maintenance manhours
- o reduce consumption of toxic chemical solvents
- o reduce expensive energy requirements, and
- o reduce costly aircraft downtime

Periodically, surface coatings and other build-up must be removed from aircraft during their normally scheduled repair and refurbishment cycles. Whether these are military, commercial, business or private aircraft, fixed wing or rotary, all must be carefully maintained and constantly inspected for the onset of corrosion.

The technique currently used to remove most protective and decorative coatings from aircraft is based on the application of hazardous, often toxic, chemical strippers. This method is expensive, time consuming, and dangerous to both man and the environment. The use of chemical strippers poses significant problems. Their use releases dangerous fumes into the work area, creates hazardous work conditions for personnel, and results in waste products which are difficult and extremely costly to dispose of.

As you can see, chemical stripping is a labor intensive operation that demands a lot of hands-on brushing, scraping, and scrubbing to help the chemicals break the paint bond between the various coatings. Oftentimes it is a long, slow process. On this F-4 wingfold for example, a total chemical stripping time of 8.3 hours is required for a satisfactory job. To protect the workers in this environment they are required to wear special air-breathing equipment, protective coveralls, boots, and gloves.

Water is constantly sprayed on the dripping chemical mess as it slides off onto the floor, damaging and eating the concrete. Tremendous amounts of water are needed in an aircraft stripping operation - up to 20,000 gallons may be required for just one stripping procedure on a plane the size of an F-4 - water which must be carefully treated prior to release back into the environment.

Due to the many variables associated in removing paint from an aircraft, such as coating depth, number and type of coatings, length of service, and compatibility of the coatings to the chemical stripper, more than one type of stripper may be required to do the job and often just chemicals alone are not sufficient. Usually it is necessary to follow up with a mechanical scraping or sanding operation to take off whatever the chemical solvents were not able to totally remove. This scraping and sanding process is injurious to the substrate, often removing much of the protective alclad and anodized coatings.

Fortunately, however, there is a better way. A system which provides an immediate, off-the-shelf solution to the ever-increasing problems and hazards that are inherent with the use of chemical strippers. Becoming known as dry stripping, the main component of this revolutionary new concept in aircraft maintenance is a synthetic, lightly abrasive, plastic media, developed by U.S. Plastic and Chemical Corporation of Putnam, Connecticut. Carefully manufactured, controlled, and sized, this material is available in three different ranges in several distinct sizes. The granular, angular shape of the individual particles enables the material to quickly and efficiently clean with a unique shearing, chipping, and cutting action that rapidly removes surface contamination and build-up. Particle shape and durable composition permit maximum productivity at low particle velocity.

The media has proved remarkably successful in a number of aircraft paint removal evaluations due to its unique characteristics. The first aircraft to be completely dry stripped using this system was an F-100 Super Saber from the Hill Air Force Base Heritage Foundation in Logan, Utah. The entire plane was stripped clean in less than 25 hours compared to the standard chemical time of 296 hours. After the dry stripping treatment the plane was repainted and put on permanent display at Hill Air Force Base.

This successful large scale application evaluation led to the dry stripping of other military aircraft, and authorization for extensive test programs to determine applicability of this process to other potential uses. Recognition of the benefits that could be realized by the dry stripping system was rapid and acceptance was quickly gained for use on the many components that must be cleaned as they are periodically removed from aircraft for various inspections and checks.

This is a typical scene of the state of the art technology that was employed to strip component parts prior to the advent of the plastic media dry stripping technique. In comparison to this hazardous, filthy mess the

dry stripping technique is clean, efficient, non-hazardous, and simple to use. Comparative time studies indicate that a 10:1 time savings ratio exists in contrast to the standard chemical stripping times.

The dry stripping method is in production use in a number of aircraft maintenance facilities. The following demonstration of component cleaning was performed at the United Airlines Maintenance and Repair Facility in San Francisco, California.

- o This component is a DC 10 high strength steel landing gear linkage. The BMS 10-11 epoxy paint is easily and rapidly removed.
- o This is a 737 aluminum wheel half. The Boeing Primer BMS10-79 is quickly removed from the base metal.
- o This is a JT-90 titanium fan blade. The anti-galling compound is rapidly removed. The rubber seal may not require removal unless damaged.
- o This JT8B fan discharge case was painted with a very tenacious primer known as Super Koropon but was stripped completely clean even in difficult access areas.
- o This actuator assembly from an F-18 presents a particularly dramatic time savings. The standard chemical stripping time allotted for this component is 2.5 hours. With the dry stripping system this component was totally cleaned in a remarkable 1.5 minutes. The need to disassemble and later re-assemble the component was eliminated.
- o This next sequence shows the removal of paint from the internal sections of an aircraft wing where there are complex structures, half sections, riveted cross members and reinforced sections. The media works well in all these areas. If he so chooses, the operator can remove only the carbonized dirt that has accumulated over the paint and not take the paint off. Or the operator can go all the way down to the primer and further to the anodized protection, which is golden color, without causing any damage to the anodide. No corrosion to these complex structures can be caused or initiated by this simple mechanical stripping process.

Due to such tremendously effective application on smaller components the next evolutionary step in the dry stripping process was evaluation on larger, off-aircraft sub-assemblies such as the wingfold from a United States Air Force F-4. On this particular wing the top layer of paint has been dry stripped off the underlying yellow primer while leaving the primer completely intact. The black strip that is being removed is a polysulfide sealant which is virtually impossible to remove with chemicals but comes off easily under the impacting media stream. The dry stripping system is currently employed in a full production facility at Hill Air Force Base to remove paint off these F-4 wingfolds. This function formerly took 8.3 hours to perform chemically and is now completed in an average of 45 minutes with the plastic stripping method.

Testing at the North Island Naval Air Station in San Diego, California has shown that the dry stripping technique is compatible with most of the sophisticated composite materials that are being increasingly incorporated in modern aircraft construction. Careful application has led to successful performance on Kevlar, fiberglass, carbon graphite, and honeycomb. Present generation chemical strippers cannot be used because they'll attack and weaken the bonding agents and resins that comprise the various composite formulations. Until the advent of this dry stripping process the only alternative was hand sanding which inevitably caused significant damage to the underlying substrate. With dry stripping it is possible to remove paint from a composite surface as easily as this with no harm to the integrity of the substrate. Paint removal from these various substrates is rapid and non-damaging. As you can see the dry stripping technique works well on advanced aerospace alloys such as magnesium and titanium, and works equally well on these composite sections that are from an F-18 fighter.

Preliminary cost analysis studies have indicated that tremendous savings can be realized by the proper utilization of this dry stripping technique. Coupled with the equally important concern for environmental controls and pollution abatement, the aircraft maintenance industry is expanding the application of this process on not only components but on the entire airframe and fuselage as well.

The United States military has been particularly active in researching methods of removing surface coatings by non-chemical means. Through this program the Air Force, Army, and Navy have recently completed tests on whole aircraft stripping, but have provided a clue to the enormity of savings that can be realized with complete up-scale utilization of the dry stripping system.

As mentioned earlier the first military aircraft to be totally stripped with the plastic media was an out-of-service F-100. A job that normally requires 296 hours to do chemically was performed in 24 hours 50 minutes with the dry stripping process. The next plane to be dry stripped was a United States Navy F-4. To ready the plane for the stripping operation the nose, canopy and afterburners were masked. Tape and plastic plugs were used to seal openings and drain holes. The plane was completely stripped in 43 hours, a startling comparison to the chemical depainting rate of 349 hours, a job performed in 12% of the presently accepted norm. Appearance of the plane was considered to be superlative after completion of the dry stripping process.

The plastic media dry stripping process is not the answer to every single surface coating removal requirement. However, properly utilized, the system offers immediate labor, material, time, equipment and energy savings in the many applications for which the process is appropriate. For instance, recent military studies show that up to 90% of the costs associated with the current chemical stripping of military aircraft could be saved by the utilization of this revolutionary new technique.

The dry stripping system looks to have equally dramatic impact on reducing hazardous waste production. It is the stated objective of the United States Department of Defense that by year end 1986 all chemical solvents will be eliminated from the waste products generated by DoD facilities. The implementation of the dry stripping technique projects to be a major factor in meeting this goal. Military estimates that are cited in this Department of Defense Environmental Protection Summary indicate that aircraft stripping wastes could be reduced by a factor of 75 to 99% with the use of the dry stripping system.

The dry stripping technique is gaining acceptance in areas outside the aircraft industry as well, in areas that all share a common concern - mainly, how to remove surface build-up in the most environmentally acceptable, most economic manner possible. This includes applications for subway, bus and railroad car cleaning, nuclear power plant decontamination, shiphold depainting, auto body treatment, and ground support equipment maintenance.

The plastic media dry stripping process offers an immediate opportunity to meet the ever increasing demands that are being forced on the modern industrial world, a world that is finally beginning to act on the inevitable dangers being created by the wide-spread use of environmentally unforgiving, dangerous, chemical pollutants. The dry stripping technique will not only be kinder to the world we live in, it will also provide a multitude of economic savings. There is an answer. It is available now. It works successfully. The savings are real.

6.0 HEALTH AND ENVIRONMENTAL CONSIDERATIONS FOR PLASTIC MEDIA PAINT STRIPPING

6.1 Occupational Health and Safety

- Worker Exposures
 - Solvents
 - Dust
 - Noise
- Safety Concerns

6.2 Environmental Considerations

- Wastes Generated by Wet Chemical Stripping
 - Solvent/Paint Residue
 - Washwater
 - Volatile Emissions
- Wastes Generated by Plastic Media Stripping

6.3 Environmental Regulations and Compliance

- Environmental Regulations
 - Hazardous Wastes
 - Wastewater Pretreatment
 - Toxic Air Emissions
 - Health and Safety
 - Volatile Organic Compound Emissions

6.4 Pollution Control Costs

- Wastewater Treatment
- Hazardous Waste

Letter from S. Vigil to B. Higgins: Health and Safety Aspects of Changing
Chemical Paint Stripping to Plastic Media Paint Stripping

Memorandum from R.H. Gorringer to Galen Seek: Heavy Metals in Bead Blast
Media

Presentation by Allan Dalpiaz, Environmental Coordinator, Hill AFB

6.0 Health and Environmental Considerations for Plastic Media Stripping

Plastic media stripping has two major advantages compared to wet chemical stripping. Both advantages result from the fact that no solvents are used in plastic media stripping. First, workers are not exposed to solvents. Many solvents used in wet chemical stripping are acutely toxic or carcinogenic or both. Plastic media does not have these characteristics. The second advantage is that no waste solvents are generated from the plastic media stripping process. This significantly reduces the load on wastewater treatment facilities.

A disadvantage of dry media stripping is that it produces dust. This is true for all blasting media, including plastic beads. Dust inhalation can cause serious health problems for inadequately protected workers. However, plastic media will not support microbial growth, reducing the risk of allergic responses associated with inhalation of dust with biological components.

Plastic media has another advantage over other dry media suitable for stripping aircraft. Dust from stripping with rice hulls, walnut shells, and other vegetable matter is explosive. Plastic media itself is not explosive, although the stripped paint particles are explosive. Mixing some plastic with the stripped paint reduces this danger.

6.1 Occupational Health and Safety

Worker Exposures

Workers in paint stripping facilities are routinely exposed to solvents, dust, and noise. These exposures present a risk to the workers' health.

Solvents

Wet chemical stripping exposes workers to a variety of solvents. Table 6.1 lists some characteristics of solvents commonly used in paint stripping

Table 6.1
CHARACTERISTICS OF CHEMICALS USED IN PAINT STRIPPING (page 1 of 2)

Chemical Name(s)	Structure	Physical Characteristics	Use	Toxicity ¹	Ambient Air Threshold ² Limit Values			Tentative Biologic ³ Threshold Limit Value
					Time Weighted Average (ppm)	Exposure Limit (ppm)	Short Term	
Freon-113 (trichloro-fluoroethane)	<chem>FC(Cl)(Cl)C(F)(Cl)Cl</chem>	Nonflammable gas	metal cleaning, aerosol propellant	Irritant. Narcotic in high concentration				Not available
Methylene chloride (dichloromethane)	<chem>ClC(Cl)C</chem>	Nonflammable liquid	paint stripper degreasing and cleaning fluids, aerosol propellant	LD ₅₀ , orally, rats 1.6ml/Kg. Narcotic in high conc. CNS depressant. May be fatal at high conc. Causes increased carboxyhemoglobin levels in blood	100	500		3% dichloromethane in blood 3% dichloromethane in expired air 3% HbCO in blood ⁴
Methyl ethyl ketone	<chem>CC(=O)CC</chem>	flammable liquid	cleaning fluid	May cause spinal column nerve damage and nausea. Irritates eyes and nose	200	300		
Mineral Spirits (Stoddard solvent, Varsol)	mixture of aliphatic hydrocarbons with some naphthenes and benzene derivatives	flammable liquid	cold cleaning baths	Dermatitis. Inhalation may cause pneumonia, pulmonary edema, and hemorrhage	Stoddard-100 (Varsol)	Stoddard-200 (Varsol)		Not available
Tetrachloroethylene (perchloroethylene)	<chem>ClC(Cl)=C(Cl)Cl</chem>	nonflammable liquid	metal degreasing	Dermatitis. Narcotic in high conc. Kidney and liver damage. Possible carcinogen	50	Not Available		8 ppm tetrachloroethylene in expired air
Toluene	<chem>CC1=CC=CC=C1</chem>	flammable liquid	paint thinner	LD ₅₀ , orally, rats 7.5 mg/Kg. Narcotic in high conc. May cause nausea, anemia, acute bronchitis, bronchospasm, and pulmonary edema. Associated with reduced male fertility.	100	150		2 g/L toluene in blood 2 g/L toluene in expired air 2 g/L hippuric acid in blood

1. LD₅₀ - lethal dose for 50% of test population.

2. Limits recommended by American Conference of Governmental Industrial Hygienists.

3. Toxicology, the Basic Science of Poisons, 2nd Edition, by J. Doull, C.D. Klaassen, and H.O. Amdur, MacMillan Publishing Co., Inc., New York.

4. HbCO - hemoglobin - carbon monoxide complex.

Table 6.1
CHARACTERISTICS OF CHEMICALS USED IN PAINT STRIPPING (page 2 of 2)

Chemical Name(s)	Structure	Physical Characteristics	Use	Toxicity ¹	Ambient Air Threshold ² Limit Values		
					Time Weighted Average (ppm)	Short Term Exposure Limit (ppm)	Tentative Biologic ³ Threshold Limit Value
1,1,1-trichloroethane (methyl chloroform)	$ \begin{array}{c} \text{H} \quad \text{Cl} \\ \quad \\ \text{H}-\text{C}-\text{C}-\text{Cl} \\ \quad \\ \text{H} \quad \text{Cl} \end{array} $	nonflammable liquid	cold metal cleaning, aerosol propellant	LD ₅₀ , male rats, 12 g/kg. Narcotic at high conc. CNS depressant. Irritant	350	450	30-50 mg/L trichloroethanol and trichloroacetic acid in urine 30-50 mg/L trichloroethane in blood 30-50 mg/L trichloroethane in expired air
Trichloroethylene	$ \begin{array}{c} \text{Cl} \quad \text{H} \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{Cl} \quad \text{Cl} \end{array} $	nonflammable liquid	paint solvent, degreaser	LD ₅₀ , orally, rats 4.9 mg/kg. Narcotic at high conc. CNS depressant. Possible liver and kidney damage. May cause death due to ventricular fibrillation. Carcinogen.	50	150	250 mg/L trichloroethanol and trichloroacetic acid in urine 2-3 mg/L trichloroethanol in blood 0.3-0.8 ppm trichloroethylene in expired air
Xylene	$ \begin{array}{c} \text{CH}_3 \\ \\ \text{C}_6\text{H}_4 \\ \\ \text{CH}_3 \end{array} $ <p>(ortho- and meta- isomers also occur)</p>	flammable liquid	cleaning agent	Narcotic in high conc. Causes liver damage, pulmonary irritation and edema. Associated with reduced male fertility. Teratogen.	100	150	2.5 g/L Xylene in blood 2.5 g/L Xylene in expired air 2.5 g/L methylhippuric acid in urine

1. LD₅₀ - lethal dose for 50% of test population.

2. Limits recommended by American Conference of Governmental Industrial Hygienists.

3. Toxicology, the Basic Science of Poisons, 2nd Edition, by J. Doull, C.D. Klaassen, and M.O. Amdur, MacMillan Publishing Co., Inc., New York.

EPA Studies Solvent, Methylene Chloride; Cancer Threat Cited

By a WALL STREET JOURNAL Staff Reporter

WASHINGTON — The Environmental Protection Agency has begun a study of whether to regulate methylene chloride, a solvent used in paint stripping and aerosols, after finding that it may cause cancer in humans.

EPA officials said that in laboratory tests mice developed lung and liver cancer, and rats developed benign tumors from inhaling the chemical.

According to the agency, 584 million pounds of the chemical are produced annually in the U.S. and another 44 million pounds are imported. The EPA said U.S. producers are Diamond Shamrock Corp., Dow Chemical Corp., LCP Chemical & Plastics Inc. and Vulcan Materials Co.

The agency figured that nearly one million workers may be exposed to the chemical, and that workplace exposures "are generally high." The chemical is used in commercial metal working; paint manufacture, application and stripping; the production of polyurethane foam and printed circuit board, and chemical processing, the EPA said.

Consumers are exposed to it primarily through insecticides, paint-removal compounds, aerosol hairsprays and antiperspirants, according to Charles Beck, a supervisor in Diamond Shamrock's electrochemicals division. The chemical also is used to remove the caffeine in producing decaffeinated coffee, he said.

Paul Cammer, executive director of the Halogenated Solvents Industry Alliance, said previous studies had failed to show a cancer threat from the chemical. He also said some scientists have questioned the reliability of findings in laboratory experiments using the type of mice used in the latest study. The alliance, he said, is financing further laboratory studies.

The EPA's review is designed to culminate in a decision by next fall to regulate the chemical, to refer it to another agency for regulation, or to conclude it doesn't pose an unreasonable risk. The review was first reported in the Washington Post.

In Birmingham, Ala., Herbert A. Sklenar, president and chief operating officer of Vulcan Materials, said that methylene chloride is "a significant product in our chemicals division," but that it accounted for less than 5% of the company's 1984 consolidated sales of nearly \$1 billion. He said Vulcan Materials is the second-largest U.S. producer of the chemical, but he declined to be more specific.

Charles Sturgeon, president of Vulcan Materials' Chemicals Division, said, "We don't believe the study was properly conducted. (The results were) not consistent with other studies that have been done" by independent as well as by industry organizations. He said the Halogenated Solvents Industry Alliance, of which Vulcan Materials is a member, already has made its views known to the EPA.

processes. The table also shows exposure limits.

Vapor inhalation is the major worker exposure mode. This is reflected in the exposure limits which are expressed as ambient air concentrations. The limits consider both local and systemic toxicity. If a chemical causes narcosis, eye or skin irritation at a low concentration, the limits are based on that concentration. Systemic toxicity, such as liver or central nervous system damage usually involves higher concentrations.

Dust

Dust is a suspension of solid particles in air and is produced by paint blasting operations. The composition and size of the dust particles depend on the surface being blasted and the blasting media. The particles' size affects their deposition. Small particles may be inhaled by inadequately protected workers, resulting in respiratory tract damage. Generally, the damage may be categorized as follows:

1. Irritation of air passages, resulting in constriction of the airways. Edema often occurs and secondary infection frequently compounds the damage.
2. Damage to cells lining the airways, resulting in necrosis, increased permeability, and edema. This edema is, in general, intraluminal (within the airways) rather than interstitial (within the cells of the airway).
3. Production of fibrosis, which may become massive and obliterate the respiratory capacity of the lung. Local fibrosis of the pleura also occurs, restricting the movement of the lung and causing pain by irritating the pleural surfaces.

4. Constriction of the airways through allergic responses. Allergic alveolitis is a common response to inhalation of simple compounds, as well as organic materials capable of producing specific allergic responses.

5. Oncogenesis leading to primary lung tumors.

The added pulmonary stress of cigarette smoking increases the risk of serious disease from occupational exposure to dust.

Inhalation of dust from blasting with corncobs, rice hulls, or other vegetable matter may result in an allergic response. The reaction is caused by a response to the vegetable matter itself, or to fungal spores or bacteria associated with the media. An example of an allergic response is farmer's lung. The disease is characterized by fever, malaise, chills with aches and pains, and weight loss. Severe difficulty breathing or a cough may also occur with lung damage.

Noise

Wet chemical stripping processes require ventilation, steaming, and sanding equipment. The equipment generates noise. Plastic media blast hoses produce noise when the beads are ejected. Both processes expose workers to excessive noise levels. For this reason, earplugs are mandatory for workers using both processes at Hill AFB. In addition, workers' hearing is tested annually as part of a hearing conservation program.

The brain interprets sounds, unlike electronic instrumentation. To take this into account, noise measuring instruments require a set of filters. Three different filters are used to measure noise levels on three different scales; the A, B and C Scales. The A scale curve corresponds roughly to the ear's response in the range from 0 to 65 dB. OSHA noise exposure limits are based on the A scale and are given as dBA levels. Continuous noise exposure limits are listed in Table 6-5.

Table 6-5

Sound Levels in dBA (slow reponse)	Duration Per day in Hours
90	8
92	6
95	4
97	3
100	2
102	1½
105	1
110	½
115	¼ or less

As an example machinery noise, a 150 cubic feet air compressor generates about a 100 dBA noise level.

Limiting the length of exposure and allowing the ear to rest between exposures helps prevent hearing loss. The use of earplugs (or earmuffs) drastically reduces workers' noise exposure.

Safety Concerns

OSHA has expressed a concern that dust generated from stripping operations poses as a possible explosion hazard. Dust from plastic media stripping contains approximately 15% plastic and 85% paint. This produces an explosive hazard equal to coal dust.

An OSHA standard (29 CFR 1910.94) states "organic abrasives which are combustible shall be used only in automatic systems . . ." This standard requires that combustible organic abrasives be used only in unmanned blast rooms. These regulations were written because of problems associated with stripping paint with vegetable organics such as walnut shells, rice hulls,

apricot pits, and corn cobs. These agricultural abrasives are more prone to cause an explosive environment, compared to the relatively low explosibility exhibited by plastic media (see Table 6.2). Although plastic media is technically an organic material (since it is a carbon compound), it is unclear if OSHA regulations are applicable.

A conflicting American National Standard (ANSI 29.4a-1981) allows the use of organic material in manned grit-blast booths when combustible dust concentrations (less than 200 mesh) do not exceed one-fourth of the minimum dust explosive level. The Navy has proposed to the Department of Labor that dry media stripping using plastic beads should be regulated by the ANSI standard instead of the OSHA standard. The Navy believes the ANSI standard is more stringent than the OSHA standard, provided a continuous airborne dust concentration monitoring system and an airflow measuring system is installed in each blast booth using organic material. The Navy recommends a monitoring system in the blasting area fitted with an alarm and an automatic shut-down device that is activated when the 200 mesh airborne dust concentration reaches 15 percent of the lower explosive limit of the organic material being used. An airflow device would shut the blast system down when the flow of air through the booth dropped below 100 ft/min for both downdraft and crossdraft ventilation. If the air flow rate in the booth is maintained at a minimum of 50 feet per minute, there is no possibility of producing an explosive air/dust mixture. Additionally, tests indicate the addition of plastic dust to the collected paint dust reduces the explosive hazard.

The Department of Labor is currently reviewing the regulations and will determine which provisions apply. It is believed that plastic media paint stripping will be allowed as long as adequate measures are taken to minimize hazards.

Table 6.2 Explosive Properties of Dry Organic Media

Property	Plastic Media			Walnut Shell
	Polyextra	Polyplus	Type III	
Explosibility Index	5	0.2	< 0.2	10
Ignition Index (°C)	440	530	> 530	430
Minimum Explosive Conc. (oz./ft ³)	0.045	0.085	0.09	0.04

6.2 Environmental Considerations

DOD facilities are using plastic media stripping to reduce hazardous waste generation. This process makes no contribution to wastewater treatment loads, unlike wet chemical stripping. It does produce a solid waste, consisting of paint chips, which is considered hazardous because of its metal content.

Wastes Generated by Wet Chemical Stripping

Wet chemical stripping facilities are the source of three pollutants; solvent/paint residue, wash wastewater, and volatilized solvent. The solvent/paint residue is collected separately from washwater at some installations. Normally, it is drummed and sent to a licensed hazardous waste disposal site. Wash wastewater, which contains paint and solvent, and dissolved chemicals, is treated before discharge to a waterway. Volatilized solvent concentrations in the work area are minimized by ventilation.

Solvent/Paint Residue

When strip baths are used, components to be stripped are immersed in tanks containing solvent. The solvent is allowed to work, the stripped parts are

removed from the tank, and washed with water. The stripping baths are replaced periodically, normally once or twice a year, and the hazardous waste, solvent/paint liquid and sludge, is disposed of at a hazardous waste disposal site.

The hazardous and toxic characteristics of the wastes generated at stripping facilities vary considerably. The hazardous constituents in the stripped paint determines the disposal method. Hazardous constituents in paints can include chromium, cadmium, and lead. Additionally, the paint stripping solvents affect disposal methods.

Washwater

Concentrated waste water from stripping baths and surface scraping contains solvent and paint residue components with the associated hazardous characteristics. However, the diluted wastes from washing contain highly variable contaminant concentrations depending on the type of paint and solvent used, the amount of solvent used, and the volume of wastewater used. Table 6.3 presents typical reported concentration ranges of hazardous characteristics found in paint stripping wastewater.

Table 6.3		
Paint Stripping Wastewater Characteristics		
Constituent	Range	
pH value, unit	6.2	- 8.0*
phenols, mg/l	17.7	- 45.2
methylene chloride, mg/l	3.8	- 219.2
chromium (hexavalent), mg/l	0.10	- 1.12
total chromium, mg/l	0.164	- 1.187
cadmium, mg/l	0.024	- 1.09
lead, mg/l	< 0.001	- 0.02

*(caustic stripper wastewater pH may be >10)

Wash wastewater is usually chemically treated in on-site waste treatment facilities to remove some pollutants (mostly metals), then discharged to municipal wastewater treatment plants for additional treatment, followed by discharge to waterways. Some facilities discharge chemically treated water directly into waterways. The on-site treatment plants generate sludge, a hazardous waste, which is transported by drum or bulk loads to hazardous waste disposal sites. Some stripping facilities have no on-site chemical treatment system and discharge untreated wash wastewater directly to municipal wastewater treatment plants for treatment.

Volatile Emissions

Air pollutants from volatilized solvents generated by stripping are difficult to quantify. Emissions from wet chemical stripping include the volatile organic compounds in the solvent, mainly methylene chloride and phenols. Little information is available about ambient air concentrations in the work space, mostly because these emissions are not yet regulated by the EPA or local agencies. There is a need to quantify these emissions to comply with OSHA requirements which specifically concern safety. The EPA is required to develop limitations for toxic air emissions in the future which will probably affect solvent stripping operations. Currently, solvent stripping areas are ventilated with large volumes of fresh air to remove harmful vapors. The ventilated air is normally discharged to the outside air where dilution and dispersion of the solvent vapors occurs.

Wastes Generated by Plastic Media Stripping

The only hazardous waste produced by plastic media stripping is the dry stripped paint residue which amounts to 120 lbs per F-4 aircraft and the dry spent plastic media which amounts to 200 lbs per aircraft -- only 34 tons per year. The savings in hazardous waste products is 1,016 tons annually, a 99.9 percent reduction, compared to wet chemical stripping.

During the paint removal process, small amounts of lead from the paint pigments, cadmium from screws and bolts, and chrome from the chromate primers, collect in the dust. These metals are present in concentrations which place the dust in the "Hazardous Waste" category. Dust waste disposal is prescribed in EPA standards for solid waste materials.

6.3 Environmental Regulations and Compliance

Painting, paint stripping, and solvent cleaning and degreasing are common to virtually all DOD facilities. Significant pollution and waste disposal problems are created by these processes. Environmental regulation plays a key role in how wastes are managed and, in some cases, dictates what paints, solvents, and miscellaneous chemicals may be used. Solvent process wastes form three principle groups: hazardous wastes (liquids, sludges, and solids), wastewater (discharge to municipal treatment waters or waterways), and air emissions. Environmental regulations covering the generation, handling, treatment, and disposal of the waste materials are established by Federal, State, and Local regulatory agencies. Most of these regulations are based on EPA standards and guidelines. In many cases the regulations and agency authority overlap, are different, and can be conflicting. As an example, California has 13 State agencies which regulate hazardous waste. The discussion of environmental regulations which follows uses EPA regulations as the basis for defining the environmental and regulatory magnitude of the problem.

Environmental Regulations

Hazardous Wastes

Almost all paint, paint stripping, and solvent cleaning and degreasing wastes are considered hazardous wastes by EPA criteria. For paints containing heavy metals, the EPA toxicity test (40 Code of Federal Regulations 261.24) may

apply. This sets maximum concentrations for heavy metals including cadmium (1 mg/l), chromium (5 mg/l), and lead (5 mg/l). Solvent and paint wastes are classified as hazardous if they are ignitable (40 Code of Federal Regulations 261.21). Solvent and paint wastes are listed hazardous wastes by generic definition (40 Code of Federal Regulations 261.31), which includes spent solvents, and specifically, trichloroethylene, xylene, toluene, methylene chloride, and methyl ethyl ketone. Some state regulations classify all paint and solvent waste as hazardous unless proven otherwise. Therefore most, if not all, wet chemical stripping and painting facilities produce hazardous wastes. These wastes must be handled, treated, and disposed of in accordance with Federal, State, and Local regulations.

Wastewater Pretreatment

The EPA has established "National Categorical Pretreatment Standards" which limit wastewater contaminate concentrations which can be directly discharged to waterways and discharged to publicly owned wastewater treatment plants. Painting, paint stripping, and solvent cleaning and degreasing wastewaters are specifically included in the EPA standards for metal finishing facilities if the facility processes also include any one of the major metal finishing operations - electroplating, electroless plating, anodizing, coatings, chemical etching and milling, and printed circuit board manufacturing (40 Code of Federal Regulations 433). Since almost all DOD facilities which include painting and solvent cleaning processes also perform one or more of the six specific metal finishing operations, the metal finishing pretreatment standards apply. The discharge limitation affecting painting and solvent operations is the "Total Toxic Organic" (TTO) limit. The term "TTO" means the total summation of all toxic organics listed (40 Code of Federal Regulations 413.11). The list includes common paint solvents, stripper compounds, and cleaning solvents, such as trichloroethane, tetrachloroethylene, dichlorobenzenes, creosols, toluenes, phenols, and trichloroethylene. The final TTO limitation for discharges to publicly owned

treatment works becomes effective July 15, 1986 for other metal finishing categories (interim TTO limitations may apply to certain cases). The TTO limit will be a daily maximum of 2.13 mg/l. The EPA recommends a long-term effluent TTO average concentration of 1.08 mg/l as a basis for design and operation in order to comply with the maximum limit. Direct discharge limitations are more strict with a maximum daily TTO of 0.58 mg/l. State and Local regulatory agencies implement these regulations. Many local municipal treatment plants set more stringent standards, as do States, for direct dischargers. For example, Texas has set a 0.3 mg/l TTO limit for NAS Corpus Christi direct discharge, and Norfolk Municipal Wastewater Plant has set a 2 mg/l phenol limit for NAS Norfolk. Disposal of painting and solvent waste waters will become more costly and require more sophisticated treatment systems to remove hazardous contaminants as regulations limiting toxic discharge are tightened. On-base wastewater treatment systems installed to meet these requirements will produce hazardous sludges which will require hazardous waste disposal.

Toxic Air Emissions

Air emissions regulations which will specifically regulate air emissions of hazardous materials are being developed by EPA in the "National Emission Standard for Hazardous Air Pollutants" (NESHAP) program. Presently, there are no national air emission standards based on environmental considerations for the types of solvents used in painting and solvent cleaning. In the EPA's NESHAP program, regulations are being developed to control toxic air emissions. EPA has only started the program, so policies, program direction, and regulation standards are not yet developed. However, priority pollutants (toxic pollutants given consideration for developing wastewater and hazardous waste regulations) will probably be evaluated first to determine if air emissions limits are needed. The priority pollutants common to painting and stripping operations include trichloroethane, phenols, toluene, methylene chloride, and trichloroethylene. The NESHAP regulations will probably

override any existing regulations. For example, existing regulations for paints limit the total volatile organic content of paints, whether the volatile compounds are toxic or not. The NESHAP regulations may specifically limit a compound, such as toluene, in the paint formula or from use in solvent cleanup and stripping solutions unless air pollution control equipment is installed. An example of expected EPA actions is provided in a report which discusses possible listing of methylene chloride on EPA's "Fast-Track" list of potential toxic air pollutants which would be reviewed on a fast track basis to determine if regulatory standards are needed (Dwyer P. and Dunphy, J.F., May 8, 1985).

Health and Safety

OSHA regulations and standards regulate worker safety and must always be considered when chemicals are involved. OSHA regulations prescribe health and safety requirements for using and handling paint, solvents, and stripper chemicals. Regulating worker exposures to toxic organic compounds used in painting and solvent processes is the responsibility of OSHA. OSHA has set maximum exposure limits to most solvent process chemicals. These limits are usually met by providing adequate work area ventilation and fresh air. One of the new OSHA programs now being implemented is the "Hazardous Communication Standard", commonly referred to as "right-to-know" standard. These regulations require additional time and expense by DOD facilities to comply with regulations where hazardous chemicals are used. The OSHA Hazard Communication Standard mandates, for the first time on a national level, that chemical manufacturers must evaluate the possible hazards for their chemicals and adequately communicate the information to users of the chemicals. Employers are required to keep employees informed of the OSHA rules, informed of any operations in their work area where hazardous chemicals are present, and trained in the health and safety aspects of working with each chemical. All employers are required to have the Hazard Communication Program in effect by May 25, 1986.

Volatile Organic Compound Emissions

The current EPA air emission standards are a result of the Clean Air Act of 1977 mandating all States to meet "National Ambient Air Quality Standards" (NAAQS). Implementation of EPA recommended paint volatile organic compound (VOC) lower limitations are only a small part of each State's program. The purpose of the NAAQS regulations are to control "photo chemical reactive" volatile organic compounds identified as smog producing organics. VOC compounds exempted from the regulations include certain volatile organic compounds, such as methylene chloride and 1,1,1-trichloroethane, because of negligible photochemical reactivity. Development of "compliant paints" which meet the EPA recommended standards was based on these standards.

To comply with the new regulations, paint formulations were changed by substituting exempt solvents for controlled solvents, decreasing solvent content as in High-solids coatings, and developing new low solvent formulas as in water-based coatings.

These regulations are intended to control smog producing organics and are not designed to control the toxic hazards. The previously discussed NESHAP regulations that will require toxic air pollutants may completely change current paint, paint stripper, and cleaning solvent formulations. EPA limits VOC compounds in paints to 420 grams/liter (3.8 lbs/gal). California set stricter limits which other states may follow as NESHAP "State Implementation Plans" are developed to meet EPA's NESHAP compliance deadline of December 31, 1987.

In summary, it is becoming costly to comply with regulatory requirements for using hazardous materials. The requirements are more stringent than those the military and industry has historically followed. They will comprehensively regulate all aspects of hazardous materials handling and disposal. Painting and solvent cleaning processes use many of the hazardous

materials that are now or will be covered by the regulations. Complying with the regulations is costly in terms of training, recordkeeping, and other direct costs. Additionally, significant costs to retrofit facilities to comply with the regulations may be required. In some cases the costs may be prohibitively expensive at a specific location and operations may have to be moved to a more environmentally acceptable location. Some present practices may be prohibited, requiring alternative substitutes to be found. Implementing programs to reduce hazardous wastes will not only reduce the problems involved with hazardous waste handling and disposal, but will also provide better and less costly compliance with general environmental, health, and safety regulations.

6.4 Pollution Control Costs

Paint stripping operations in the Navy produce an estimated 300 million gallons per year of wastewater and 9 million gallons of hazardous waste (Law, A.L., and Olah, N.J., 1984). Similar volumes of wastes are generated in Army and Air Force facilities. The combined volume of paint stripping wastes from Army, Navy, and Air Force facilities is estimated to be over 1 billion gallons of wastewater and 30 million gallons of hazardous waste annually. Direct wastewater disposal costs are estimated to be \$2 million annually (based on average municipal disposal fees of \$2 per 1,000 gallons) and direct hazardous waste disposal costs are estimated to be \$30 million annually (based on average hazardous waste disposal cost of \$1/gallon). When all costs associated with handling and treating the wastes are included, the actual costs are many times greater than the direct disposal costs. As new and proposed future regulations are implemented, direct waste disposal costs will increase, and could easily double or triple in the near future.

Wastewater Treatment

Solvent stripping operations use large volumes of wash water which must be chemically treated before discharge. Plastic media stripping uses no water.

For F-4 aircraft, the wash water waste amounts to approximately 200,000 gallons per aircraft. Wastewater from wet chemical stripping must be pretreated before discharge to municipal treatment plants. Pretreatment programs must consider all waste inputs and treatment systems must be developed to meet effluent criteria. Hill A.F.B., Ogden, Utah, recently completed an engineering study and cost estimate evaluating alternatives to meet the new pretreatment standards for toxic organic compounds (Radian Corp., 1985, Case, Lowe and Hart, Inc., 1985). The principle waste sources contributing toxic organic compounds were identified as the painting and paint stripping operations. The pretreatment system design included filtration, air stripping, and carbon adsorption to remove toxic organic compounds from the wastewater. The estimated system construction cost is \$2,777,750 and annual operating costs are estimated to be \$1,028,000. These costs are in addition to the existing on-site treatment plant which removes metals and other conventional pollutants.

Thirty-five percent (210,000 gal/day) of the 600,000 gallons per day of wastewater treated in the existing on-base industrial waste plant is generated from solvent stripping operations. 20,000 - 30,000 gallons of water is used to wash off the stripper and paint residue for each stripper application. Several applications of stripper are normally required. Water is also used to wash floors and general area maintenance which all contributes to the wastewater flow. Annual cost of chemicals to operate the industrial waste plant is \$912,500. Reducing the waste flow by 35 percent is estimated to reduce treatment chemical use by an equal percentage and save \$319,375 annually. Additional savings in maintenance and operational expenses, such as equipment repair and replacement, and labor, for the industrial waste plant will also probably be realized. Assuming these, annual operation and maintenance costs amount to 60 percent of the estimated \$2.3 million capital cost of the new plant. The 35 percent decrease in flow to the pretreatment facility should reduce these costs by 15 percent. The operation and maintenance cost savings will be \$207,000 annually. The total

estimated annual chemical and operational cost savings are \$526,375 (see Table 6.4).

Hazardous Waste

The existing Hill A.F.B. wastewater treatment plant produces approximately 3,000 tons of sludge per year which is 10 percent solids by weight. The sludge is classified as a hazardous waste because of its metal content. The sludge is transported by truck to California where it is disposed at a licensed hazardous waste disposal site for a total cost of \$200/ton. The waste water containing solvent and paint residual generated from solvent stripping F-4 aircraft is estimated to contribute 35 percent of the total sludge produced from Hill A.F.B. Therefore, solvent stripping contributes approximately 1,050 tons of the total 3,000 tons produced annually. The only hazardous waste produced by plastic media stripping is the dry residue consisting of paint chips (120 pounds per aircraft) and spent plastic media (200 pounds per aircraft) -- only 34 tons per year. The decrease in hazardous waste production is 1,016 tons annually, a 99.9 percent reduction, and \$218,000 savings in annual disposal costs. Refer to Table 6.4 for savings estimates.

Table 6.4
Savings Comparison*
Plastic Media vs. Solvent Paint Stripping

Item	Savings	Annual Cost Savings
Hazardous waste	Generates 1/100 the waste sludge which requires hazardous waste disposal	\$ 218,000
Wastewater Pollution	Eliminates generation of 210,000 gallons per day of wastewater which must be treated in an on-base waste treatment plant before discharge to the City municipal treatment plant	\$ 526,375
Materials	Eliminates the use of chemical solvents/ requires minimal use of plastic media to make up for worn out media	\$1,091,340
Total Annual Pollution Control Savings for 215 F-4 Aircraft		\$1,835,715

* Quantity and cost saving estimates are based on stripping 215 F-4 aircraft annually.



DEPARTMENT OF THE AIR FORCE
UNITED STATES AIR FORCE HOSPITAL HILL (AFLC)
HILL AIR FORCE BASE, UTAH 84056

REPLY TO: SGB (Mr. Vigil/71078)
ATTN OF:

9 Jul 85

SUBJECT: DOD Environmental Leadership Project, Plastic Media Paint Stripping, Hill Air Force Base

TO: Mr. Brian P.J. Higgins, PhD, PE
Training Program Manager
1160 Rockville Pike, Suite 202
Rockville, Maryland 20852

1. In your letter dated 7 Jun 85, and our telephone conversation, you requested information concerning the health and safety aspects of changing from chemical paint stripping to plastic media paint stripping. This office will provide separate safety and health information along with a little history of each operation.
2. Building 220, Aircraft Cleaning and Disassembly, was constructed and was put into operation in 1957. The aircraft hanger featured a unique mechanical ventilation system, the design of which was years ahead of the "state of the art."
3. Chemicals of various types were and are being used to clean or strip paint from aircraft or aircraft component parts. Presently such chemicals as PD-630 Type II, alkaline base soap, and various types of paint strippers are being used at Bldg 220 (reference Attachment 1 for list of chemicals and their specific use).
4. In Building 220, the aircraft cleaning and paint stripping hangar and small parts paint stripping shops are large open areas with good mechanical exhaust and make-up ventilation systems that remove chemical vapors from the work areas (reference Attachment 2). The make-up air enters through the entire west wall, moves across the entire cross section of the hangar, and is exhausted at the east wall by 16 exhaust ventilation fans. Air flows through the entire hangar at a rate of 500,000 cubic feet per minute. The small parts paint stripping shop has three combined exhaust hoods that remove all chemical vapors during small parts paint stripping operations.
5. All employees are provided and are required to use coveralls, rubber gloves, goggles, face-shields, rubber boots, respirators (dust, cartridge type, and airline hood) and, when needed, rubber coveralls with hood while using or handling chemicals.

AFLC - Lifeline of the Aerospace Team

6. Industrial hygiene surveys of Building 220 have indicated that employees working in the paint stripping hangar do not use chemicals eight hours per workday, five days per workweek. Employees working in the small parts cleaning and stripping area do use chemicals eight hours per workday, five days per workweek. However, air samples collected in these two work areas, on all chemicals used, have been below the allowable Time Weighted Average (TWA) exposure concentration per AFOSH Standard 161-8 and OSHA 1910.1000.

7. Noise levels from disc sanders, steam cleaners, and ventilation systems range from 82-92 dBA. Employees are required to use ear protection while using this equipment and when working near the exhaust ventilation systems.

8. Occupational physicals are based on our air samples, potential risks, history of work area (Compensation Claims submitted, accident investigating and Environmental Differential Pay submittals, etc.). All employees are provided with Occupational Physical Examination No. T-13, which entails:

- a. Liver functions.
- b. Urinalysis (albumin sugar).
- c. Skin examination.
- d. Urine phenol.
- e. Superficial eye examination.
- f. Biological indicators.
- g. Audiograms.

9. The bead blasting operation at Bldg 232 will not pose the potential safety and health hazards of the chemical cleaning and paint stripping operations in Building 220. However, the following safety and health measures will be required during bead blasting operations.

- a. Use of abrasive blasting breathing airline hoods, coveralls, leather gloves, and safety shoes.
- b. Ear protection.
- c. All mechanical ventilation systems will be operational.
- d. Hangar doors must remain closed.
- e. Employees leaving the work area while other employees are bead blasting shall disconnect the breathing airline from the hood and walk outside the building before removing the hood.
- f. Employees will not enter the facility during the bead blasting operating unless they are wearing an abrasive blasting hood.
- g. Workers removing or cleaning bead blasting from floors, aircraft or equipment (with shovels, compressed air guns, brooms or brushes) shall wear coveralls, dust respirators and goggles.

h. Breathing air shall be connected to a filter system which removes water, oil, odor, organic and carbon monoxide. Breathing air shall be connected to a carbon monoxide warning device.

10. Noise readings taken inside the abrasive blasting area indicated levels which ranged from 91 to 95 dBA. Ear protection is required.

11. All employees will be provided with Occupational Physical Examination No. T-23, which entails:

- a. Biological indicator.
- b. Audiogram.
- c. Complete blood count.
- d. Chest x-ray.
- e. Urinalysis.
- f. Pulmonary function.
- g. Visual acuity.
- h. Skin examination.

12. The following Air Force Regulations and Standards are applicable to these two operations:

<u>Hazard</u>	<u>Regulation or Standard</u>
Hazardous noise exposure	AFR 161-35
Personal protection equipment	AFOSH Std 127-31
Respiratory Protection Program	AFOSH Std 161-1
Industrial ventilation	AFOSH Std 161-2
Permissible exposure limits for chemical substances	OSHA 1910.1000 and AFOSH Std 161-8
Exposure to inorganic lead	AFOSH Std 161-16
Standard Occupational Health and Aerospace Medicine Program	AFR 161-33 and AFOSH Std 161-17

13. If additional information is required, contact Mr. T. Sam Vigil at telephone number 801-777-1078.


T. SAM VIGIL, Asst. Chief
Bioenvironmental Engineering Svcs.

2 Atch
1 Bldg 220 Chemicals
2 Exhaust Ventilation System

ATTACHMENT 1

CHEMICALS USED BY CLEANING & DISASSEMBLY BLDG 220

SOLVENT: PD 680 type II. It is low grade kerosene and is used for washing down engines and engine plumbing. You must use goggles, coveralls and gloves. It has a flash point of 138° F, and a TLV of 500 PPM. In confined areas use breathing airline respirators.

CLEANING COMPOUND: MIL-C-87936 is an alkaline water base soap and MIL-C-43616 which is a solvent emulsion type soap. They are both used for washing aircraft and small parts. You must wear goggles, rubber gloves, coveralls and respirator with organic type filters. MIL-C-43616 has a flash point of 190° F, and a TLV of 500 PPM.

PAINT REMOVER LACQUER: MIL-R-25134B, methylene chloride base, used in stripping small parts that are painted with lacquer. You must use goggles, coveralls, rubber boots and rubber gloves. If area is not properly ventilated, use respirator with organic type filter. It has no flash point and the TLV is 100 PPM.

PAINT STRIPPER: B&B 5075-NP, is an acid base stripper used for stripping aircraft. Care must be used to make sure you do not get it on skin or clothing. The acid will give a burning sensation of the skin and discolor it for a time. Rubber boots, goggles, rubber gloves, a combination acid and organic type cartridge will be used, or an airline hood respirator with rubber suit. It has no flash point and the TLV is 100 PPM for methylene chloride.

PAINT STRIPPER: Turco 5873 is a non acid paint stripper to be used on high strength steel, and magnesium parts. You must wear goggles, coveralls, rubber boots and rubber gloves if you do not have proper ventilation use a ~~respirator~~ with an organic and acid type cartridge respirator.

HOT TANK STRIPPER: Eldorado NR P2230, MIL-R-83693 is used to clean paint and grease from small parts that are impractical to strip by hand. It is also used to remove paint from large items that require longer exposure to stripping compounds to remove the paint. You must use goggles and rubber gloves when placing items in, or removing items from the tank. The effects of this stripper is narcosis, dizziness and possible loss of consciousness. Emergency and first aid procedures: Remove person to well ventilated area. If in eyes rinse area with cold water, and ~~consult~~ medical aid.

See K

for 15 min. water

Should be supplied for methylene chloride

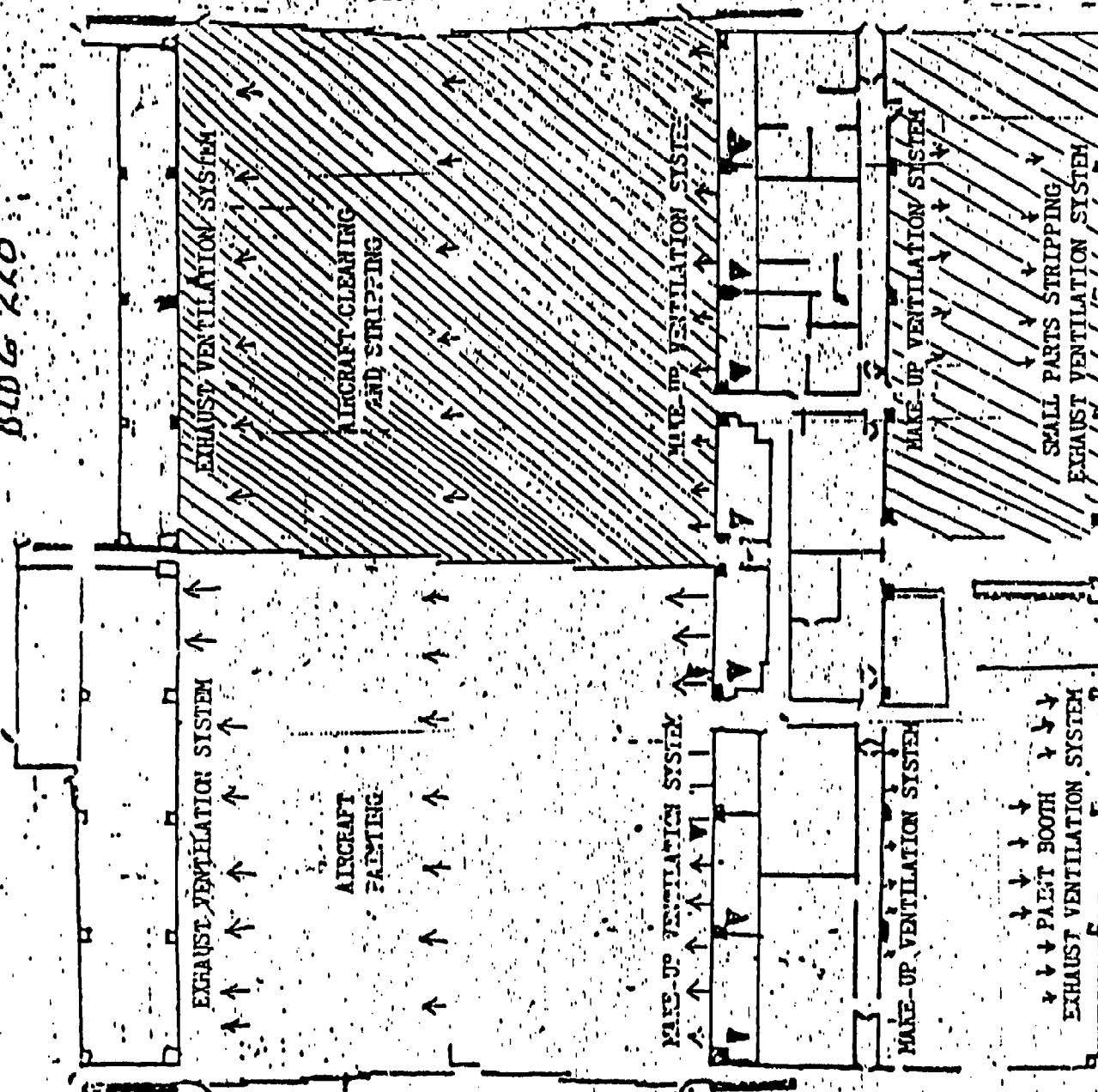
organic cartridge lots of use with most supplies

ATTACHMENT 2

CORROSION CONTROL FACILITY, BUILDING 220

BLDG 220

HANGAR DOORS



AIR INTAKE

AREA WHERE EMPLOYEE WAS ASSIGNED TO WORK.

635105F

SCALE - 1"=40'0"



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFLC)
HILL AIR FORCE BASE, UTAH 84056-5149

REPLY TO
MAQC (72302)

SUBJECT Heavy Metals in Bead Blast Media (85-1622-83)

TO MABEB (Galen Seek)

1. Samples came from a water trap of bead blast dust. Since our dry bead blast residue proved to be EP toxic and therefore, hazardous waste, these samples were submitted to determine correct disposal procedures. The water in the trap can be decanted so we determine the EP toxicity on the liquid and the solid separately. Then the solids were digested and analyzed for total metals. Results in parts per million follow:

	Liquid (EP Toxicity and Total)	Solids (EP Toxicity)	Solids (Total)
Cr (total)	3.5	9	192
Cd	0.2	23	68
Pb	0.7	1.7	209
Cr (VI)		4.4	

2. Based upon the analysis, the liquid portion may be decanted off and disposed of in the industrial drain. Solids should be retained and turned in as hazardous waste.

R Hal Gorringe

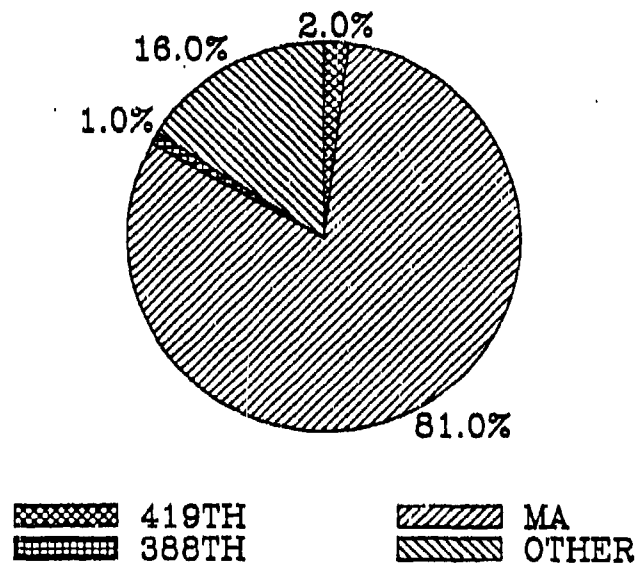
R. HAL GORRINGE, Chief
Chemical Laboratory
Directorate of Maintenance

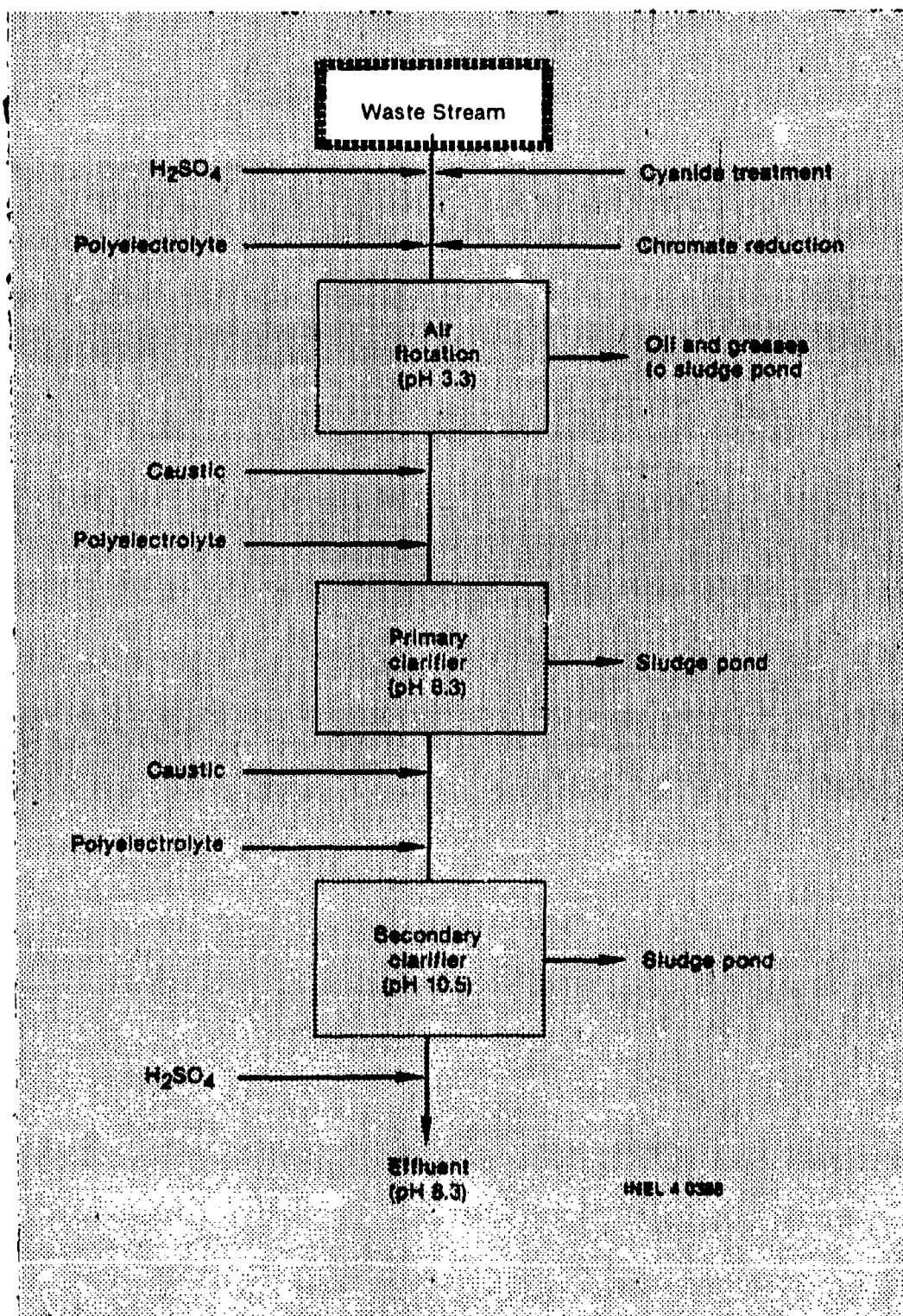
Presented by Allan Dalpias, Environmental Coordinator, Hill AFB

INDUSTRIAL WASTEWATER TREATMENT PLANT HISTORY

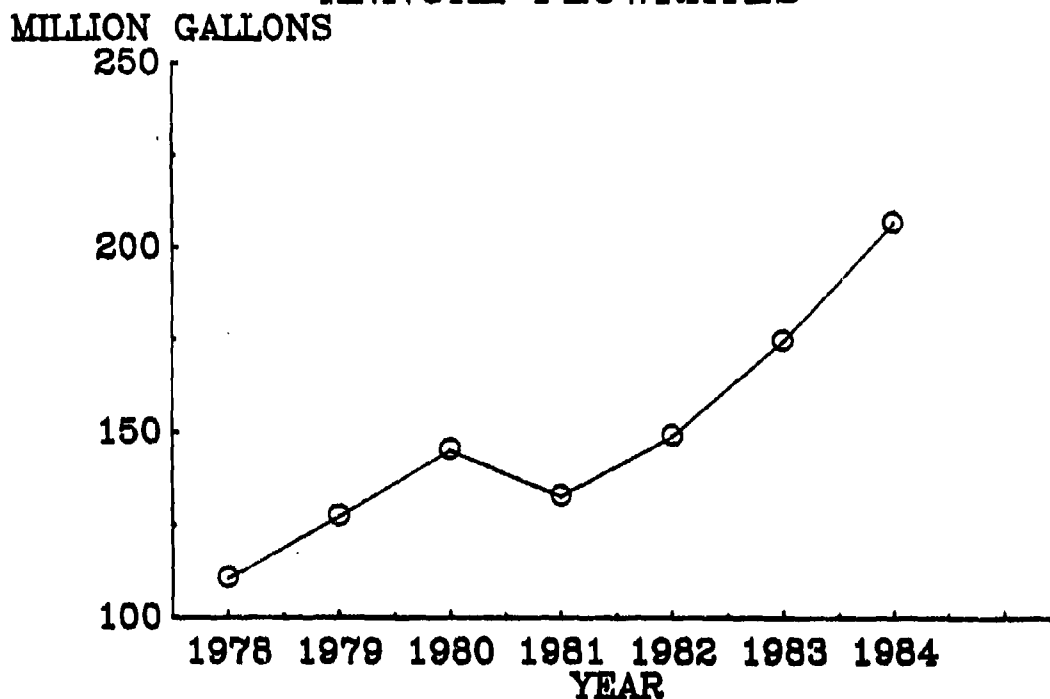
YEAR	DESIGN FLOW
1956 PLANT START UP	.33 MGD
1960 PLANT MODIFIED	.5 MGD
1971 PLANT MODIFIED	1.0 MGD
1979 PLANT MODIFIED	1.5 MGD

INDUSTRIAL WASTEWATER GENERATORS





INDUSTRIAL WASTEWATER TREATMENT PLANT ANNUAL FLOWRATES



INDUSTRIAL WASTEWATER TREATMENT PLANT CURRENT OPERATIONS

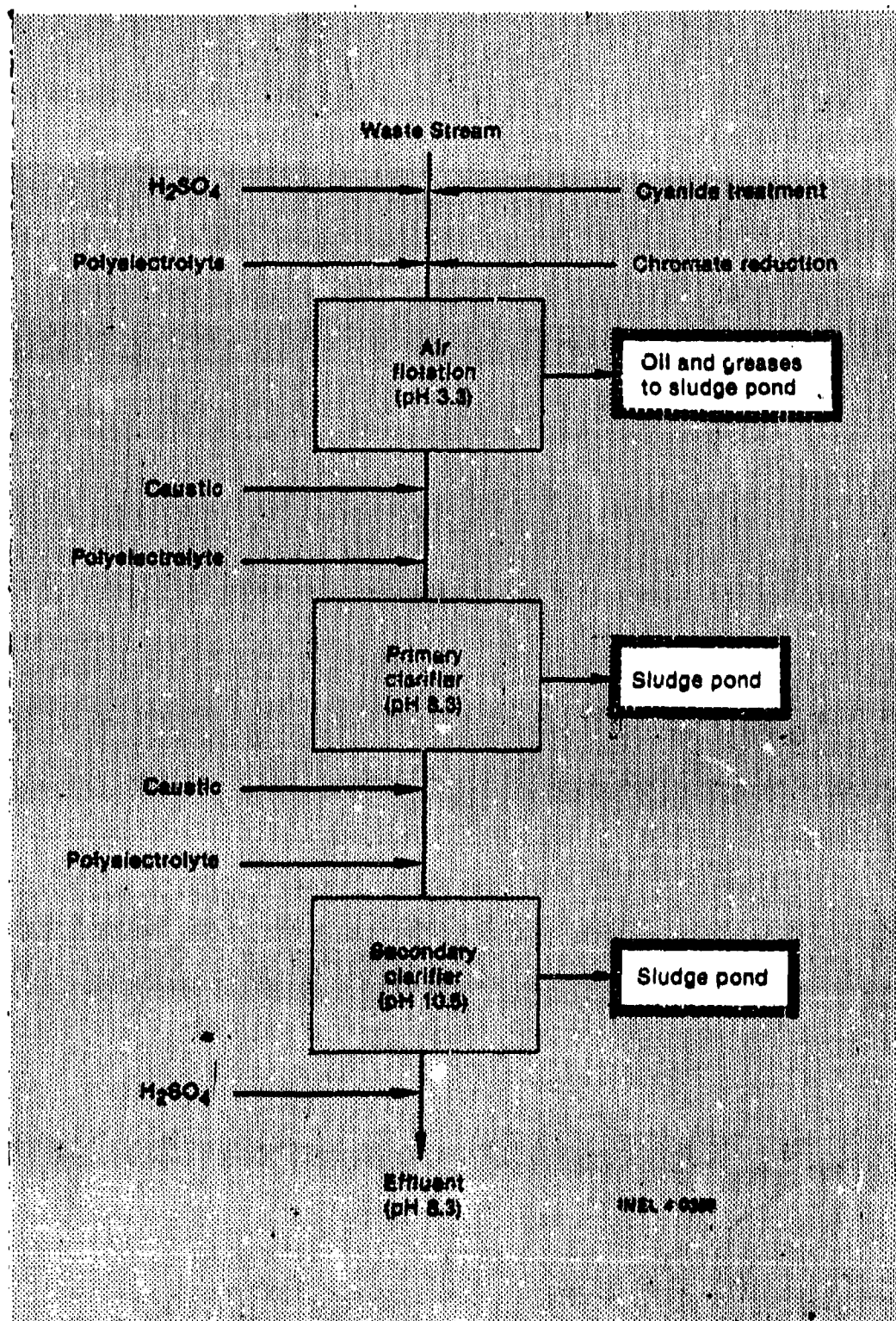
● 24 HOUR-7 DAYS PER WEEK OPERATION

● PROVIDES TREATMENT FOR:

- *OILS AND GREASES
- *HEAVY METALS
- *CYANIDES
- *ACIDS AND BASES

● SERVES:

- *MAINTENANCE DIRECTORATE
- *388TH TACTICAL FIGHTER WING
- *419TH TACTICAL FIGHTER WING
- *6514TH TEST SQUADRON
- *CIVIL ENGINEERING DIVISION



INDUSTRIAL WASTEWATER TREATMENT PLANT CURRENT PRETREATMENT STANDARD VIOLATIONS

POLLUTANT	PERCENT VIOLATIONS
TOTAL TOXIC ORGANICS GREATER THAN 90%	
CHROMIUM	15.1%
SILVER	11.5%
LEAD	9.0%
CADMIUM	1.8%
NICKEL	0.6%
CYANIDE	0.5%

PLASTIC MEDIA PAINT STRIPPING ENVIRONMENTAL IMPACTS

- ENHANCES PUBLIC RELATION EFFORTS WITH THE STATE OF UTAH AND THE FEDERAL EPA.
- WILL REDUCE THE AMOUNT OF HAZARDOUS WASTE GENERATED AS REQUIRED BY THE 1984 AMMENDMENT TO THE RESOURCE CONSERVATION AND RECOVERY ACT.
- REDUCES THE LOAD ON THE INDUSTRIAL WASTEWATER TREATMENT PLANT
 - * REDUCES THE WASTESTREAM FLOW
 - * REDUCES TOTAL TOXIC ORGANIC LOADING
 - * REDUCES SLUDGE HANDLING COSTS

7.0 Demonstrations and Tours

- 7.1 Full-Scale Prototype for Plastic Media Paint Stripping of Fighter Aircraft (Building 223)
- 7.2 Modular Equipment for Plastic Media Paint Stripping of Aircraft and Components (Building 236)
- 7.3 Conventional Paint Stripping (Building 220)
- 7.4 Industrial Wastewater Treatment Facility (Building 575)
- 7.5 Defense Property Disposal Office (Building 55)
- 7.6 Metallurgical and Nondestructive Test Branch (Building 100, Bay E)

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APPENDIX

1.0 Policy Documents Concerning DoD Hazardous Waste

- 1.1 The Hazardous and Solid Waste Amendments (Ward and Harris, March 1985)
- 1.2 Executive Order 12088, Federal Compliance with Pollution Control
- 1.3 DEQPPM 80-5, DoD Hazardous Material Disposal Policy
- 1.4 DEQPPM 80-8, RCRA Hazardous Waste Management Regulations
- 1.5 DoD 4160.21-M, Defense Disposal Manual, Chapter XXI, Hazardous Property Management

2.0 Selected Project References

- 2.1 Paint Removal Through Plastic Bead Blasting - The Sensible Way (Roberts, February 1985)
- 2.2 Effects of Plastic Bead Blasting for Paint Removal on Magnesium and Aluminum Aircraft Wheels (Seppi, 8 July 1985)
- 2.3 Plastic Bead Blast Paint Removal Booth (CH2M HILL, April 1985)
- 2.4 Abrasive Blast Cleaning, A Viable Alternative to Chemical Paint Stripping (Gardiner)

3.0 Manufacturers' Literature

- 3.1 U.S. Technology Corporation
Blast Cleaning Media
- 3.2 Clemco
Abrasive Blast and Recovery System
- 3.3 Pauli & Griffin
Closed Cycle Spot De-Painting Machines
Plastic Reclaimable Abrasive Machines
- 3.4 Schmidt
Plastic Blast Media System - Blast N' Vac

HAZARDOUS WASTE MANAGEMENT

APPENDIX 1.1

The 1984 Hazardous and Solid Waste Amendments: A Bold Experiment in Hazardous Waste Management

Bud Ward

The Environmental Forum
Washington, D.C.

Christopher Harris

Zuckert, Scoutt, Rasenberger and Johnson
Washington, D.C.

The 1984 amendments by Congress to the Resource Conservation and Recovery Act (RCRA) resulted primarily from a sense of frustration with EPA's apparent lack of progress in addressing the myriad problems associated with hazardous waste management. The amendments were also a manifestation of Congress' clear sense of purpose in wanting to steer a radically different course at much greater speed. Whether this bold experiment works remains to be seen. EPA appears to be committed to carrying out both the letter and spirit of the Hazardous and Solid Waste Amendments of 1984, but no one should underestimate the magnitude of the task.

"Cradle to grave."

The term gained currency in the environmental field in the mid-seventies. "From beginning to end," it was meant to imply . . . and all in between. No voids or loopholes.

The "cradle to grave" approach was what Congress had in mind when in 1976 it passed the Resource Conservation and Recovery Act. By enacting RCRA Congress believed it was "closing the loop," that is, extending to the land the kind of regulatory safety net previously extended to air through the Clean Air Act and to water through the Federal Water Pollution Control Act. Among the reforms mandated by that Act was the requirement that generators comply with a comprehensive manifest system, a method by which hazardous wastes would be traced from the point of manufacture through to their ultimate—and presumably safe—disposal or destruction.

However, the theory and practice didn't quite match. And the public's awareness of that fact (prompted in part by Congressional scrutiny of the RCRA program) ultimately lead to the enactment in 1984 of a dramatic overhaul of the entire RCRA waste management system. Looking back over the past few years it is apparent that a number of

related factors converged in the early 1980s to set the stage for the revolutionary changes that Congress prescribed.

First, it became increasingly clear to the Congress that far more hazardous waste actually was being produced each year in the United States than previously had been estimated. In 1980 while EPA was working to develop implementing RCRA regulations, and as Congress in 1982 began to consider reauthorization of RCRA, estimates were that some 11 billion gallons—40 million metric tons—of hazardous wastes were produced each year in the U.S. By mid-1983, however, the estimated amount of hazardous waste produced in the United States increased to about 40 billion gallons annually—150 million metric tons—a nearly fourfold increase. In mid-1984, EPA's final "National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities" calculated that the amount of hazardous wastes generated each year in the U.S. in fact totaled more than 71 billion gallons—264 million metric tons. The actual quantity was widely acknowledged to be higher since various categories of hazardous waste (such as the amount produced by the so called small quantity generators) were not included in the survey.

Second, reliance on land disposal of

hazardous waste continued unabated. EPA's National Survey revealed that far more hazardous waste was disposed of in surface impoundments, in underground injection wells or landfills than through incineration or other methods of treatment. In fact, less than one-fourth of the nation's hazardous waste treatment capacity was being used, according to the EPA study.

Third, concern over groundwater contamination became widespread throughout the early 1980s. The public's awareness of groundwater contamination increased dramatically as a result of investigations of the environmental and health problems associated with hazardous waste sites under the Comprehensive Environmental Response, Compensation and Liability Act (commonly known as Superfund). Superfund sites were blamed, in large part, on the failure to require operating hazardous waste sites to comply with the most basic safeguards to protect groundwater. At the same time leaks from underground storage tanks that caused the contamination of drinking water supplies in dozens of communities received national media attention.

Fourth, as Congress investigated the integrity of hazardous waste landfills, it came to the conclusion that there is no such thing as a "secure" landfill (particularly for liquid wastes) and that virtually all conventional landfills ultimately will leak into subsurface soils and groundwater. Congress also learned that an even greater danger is posed by surface impoundments because they receive much larger quantities of waste and because four out of ten impoundments have no liner. (Very few have been equipped with double liners.) Proponents of the 1984 RCRA Amendments were convinced that continued

overdependence on these methods of land disposal created an unnecessary risk to human health and the environment, particularly since cost-effective methods of treatment were available.

Driven primarily by these considerations, but also clearly influenced by the political controversies surrounding EPA mismanagement of the hazardous waste programs during the first two years of the Reagan Administration, Congress in 1984 succeeded in doing what it previously had been unable to do since the December 1980 passage of Superfund: that is, enact a major piece of environmental legislation. In fact, President Reagan's November 8, 1984 signing of the Hazardous and Solid Waste Amendments of 1984 constituted the final step of the most comprehensive revision of any environmental law since the 1977 rewrite of the Clean Water Act.

Land Disposal Provisions— The Heart of the New Law

Despite the enormous scope of the 1984 amendments, it is not difficult to single out the set of provisions that form the keystone of the new statute. As expressed in the provision setting forth its findings and objectives, Congress declared that certain classes of land disposal facilities are not capable of assuring long-term containment of certain hazardous wastes. To avoid substantial risk to human health and the environment, Congress said reliance on land disposal should be minimized or eliminated, and it said land disposal, particularly landfill and surface impoundments, should be the least favored method for managing hazardous wastes.

To accomplish this purpose, the 1984 amendments provide EPA with unusually detailed instructions on cutting back on land disposal. Section 201 requires EPA by November 1986 to promulgate rules to prohibit land disposal of dioxins and solvents unless the EPA Administrator affirmatively finds, "to a reasonable degree of certainty," that the prohibition on land disposal of those wastes is not necessary to protect public health and the environment. Eight months later, all "California list" wastes (arsenic, cyanide, mercury, lead, halogenated organics and several other hazardous wastes) are banned from land disposal unless the Administrator makes the same type of finding.

The law also gives EPA rolling deadlines of 45, 55 and 66 months by which it must adopt rules or make similar "not necessary" findings on land disposal of all remaining listed and identified hazardous wastes, with EPA to decide the first third of the wastes within 45 months, another third within 55 months and the final third by the end of 66

months after enactment. In a unique Congressional strategy known as the "hammer," Congress mandated that the land disposal bans will take place automatically if EPA misses the statutory deadlines for acting on its own.

Section 202 of the 1984 Amendments specifies that for new, replacement, or expanded landfills permitted after November 8, 1984 EPA's minimum acceptable technology standard must provide for at least two liners as well as for a leachate collection system above and between the liners.

In Section 215 Congress went beyond the issue of addressing merely new surface impoundments and extended additional control requirements also to existing impoundments. Specifically, Congress established detailed technological retrofit requirements—double liners and leak detection, or their equivalents, along with groundwater existing monitoring requirements—as the minimum standard. Unless these impoundments are allowed an exemption through a limited variance, the impoundments have four years in which to comply; otherwise they can no longer receive, store, or treat any hazardous wastes.

Leaking Underground Storage Tanks

It is worth mentioning that the Hazardous and Solid Waste Amendments were not limited to hazardous and solid wastes. The new law also creates a major new regulatory program to control leaks from the uncounted hundreds of thousands of underground product storage tanks around the country. As a result, it is quite possible that the underground storage tanks regulatory program could be as large as all other elements of the RCRA program.

In passing the new regulatory program, Congress was acting on information, compiled by the Congressional Research Service, that probably somewhere between 75,000 and 100,000 tanks are leaking into the groundwater, surface water, or subsurface soils and that another 350,000 will be leaking in the next five years. However, the actual number of underground storage tanks in the United States is unknown, as is the number of tanks actually leaking. Given that many tanks are believed to be nearing the end of their expected 15–20 years life spans, estimates are that a great many more tanks will begin leaking over the next decade.

HAZARDOUS WASTE MANAGEMENT

Congress in Title VI mandated adoption of a new regulatory program applying to tanks (and connected piping) that store at least 10% of the total volume of their "regulated substance" underground. The program is to apply to petroleum products and hazardous substances designated under Superfund.

To assist EPA and the states in developing a nationwide inventory of underground tanks, owners of underground tanks have until May 1986 to notify a designated state or local agency of the existence of each tank as well as its age, size, type, location and uses. Similar information is also required for tanks which have been taken out of operation since January 1, 1974.

On the regulatory front, EPA is charged with promulgating leak detection, prevention, and corrective action regulations for underground storage tank owners. EPA's regulations, which will apply to new as well as existing tanks, must be "sufficient to protect human health and the environment" and they may take into account differences in climate conditions, tank use and age, hydrogeology, and other factors. EPA also has authority under the law to adopt rules on insurance or other forms of financial responsibility for corrective actions and for compensation to third parties for bodily injury or property damages.

Title VI also prohibits the installation of "bare steel" tanks (i.e. those without adequate corrosion protection) unless properly conducted soil tests show that the resistivity (the corrosion potential) of the soil is 12,000 ohm/cm or greater. Although the Administrator is authorized to modify this prohibition, it is not likely that it would be made less stringent.

Small Quantity Generators

When EPA promulgated its RCRA regulations in 1980, it exempted "small quantity generators" (those producing up to 1000 kg of hazardous waste per month) from most RCRA requirements. This regulatory decision in effect allowed those generators to dispose of wastes directly in sanitary landfills or into sewers, practices not generally regarded as safe. This "regulatory loophole," as critics described it, also exempted small quantity generators from having to notify transporters that the wastes being transported were in fact hazardous.

In response to EPA's unwillingness to impose any substantial requirements of small quantity generators, Congress in the 1984 Amendments mandated that anyone producing between 100 and 1000

kg of waste per month must, by August 1985, properly identify the wastes being transported off-site for treatment, storage or disposal. While requiring that the wastes be properly manifested, the new law states that generators in the 100-1000 kg/month range need not comply, at least initially, with the more complex requirements such as waste testing. Under the law, EPA is to complete a study of small quantity generators by the end of March 1985, and by March 1986 it must adopt rules for small generators in the 100-1000 kg/month range. If the Agency fails to promulgate rules by the end of March 1986, small quantity generator wastes as of that date must go only to hazardous waste treatment, storage, or disposal facilities permitted under Subtitle C of RCRA.

Burning and Blending

Another regulatory "loophole" that caused Congress a great deal of concern was the exemption for facilities burning hazardous wastes for the purpose of "energy recovery." The practice of blending of hazardous wastes (such as PCBs or chlorinated solvents) with heating oil for subsequent sale to unsuspecting customers had become a serious potential health problem in New York and New Jersey, and Congress was in no mood to allow it to become a nationwide health threat. Of particular concern to the Congress was the possibility—and even likelihood—that more and more hazardous wastes would be burned in boilers and other heat recovery facilities precisely to avoid RCRA regulation and the costs of treatment or disposal.

To address the "burning and blending" problem, Congress mandated that EPA be notified by facilities blending hazardous wastes with fuel for distribution or marketing for energy recovery. EPA has until November 1987 to adopt standards for transporters and facilities burning fuels containing hazardous wastes. In addition, purchasers of such fuels must be notified of the hazardous makeup of their fuels. Certain exemptions from the rules are provided for petroleum coke and for *de minimis* quantities of hazardous wastes. Onsite petroleum refinery operations are specifically exempted from the labeling requirements.

Continuing Releases—The "Mini-Superfund"

Section 206 of the 1984 Amendments, "Continuing Releases at Permitted Facilities," has been described as a "Mini-Superfund," as something of a "sleeper" within the overall Amendments.

In passing Section 206, Congress was concerned that EPA regulations did not require facilities permitted under RCRA to address all releases of hazardous wastes from all solid waste management units at a particular facility. "A facility which is causing, for example, groundwater contamination from inactive units could, therefore, seek a permit under RCRA for active units and receive the permit without having to clean up the contamination," Senate Environment and Public Works Committee Counsel Steven J. Shimberg has written.

Under the new law, permits must require "corrective action for all releases of hazardous waste or constituents from any solid waste management unit at a treatment, storage, or disposal facility seeking a permit (under Subtitle C) regardless of the time at which waste was placed in such unit."

Writing in *Legal Times of Washington*, attorneys James A. Rogers and Dorothy A. Darrah of Skadden, Arps, Slate, Meagher & Flom in Washington, D.C., have stated accurately that Section 206 "is designed to remedy the situation in which a landfill owner attempts to demonstrate to EPA that contamination in groundwater emanates from 'old' (pre-RCRA) disposal and that therefore remedial action required as part of a RCRA permit is inappropriate." According to Rogers and Darrah, under EPA's current regulations, an owner need not clean up plumes of contamination under a facility when those plumes are attributable to wastes disposed of prior to the effective date of EPA's groundwater cleanup (corrective action) requirements. "Congress now has deemed this dichotomy unacceptable," they wrote. Rogers and Darrah see in the Section 206 provisions "enormous implications for the many industrial sites with subsurface contamination resulting from pre-RCRA activities. The new section appears to say that any permit issued (by EPA or an authorized state) must require the cleanup of problems at all areas on the site even if the source of the pollution would not itself now be regulated as a hazardous waste unit under RCRA because the materials disposed of are not hazardous wastes or because they were placed there before RCRA, or both."

However, in order to avoid delays in the permit process, Congress provided that permits may be issued with compliance schedules for corrective action in cases where the corrective action cannot be completed prior to issuance of the permit.

Imminent and Substantial Endangerment and Citizen Suits

Although RCRA is fundamentally a regulatory scheme for addressing hazardous waste problems, it also provides

EPA under Section 7003 with the ability to obtain injunctive relief against any person contributing to an "imminent and substantial" endangerment created by the handling, storage, treatment, transportation or disposal of any solid or hazardous waste. According to a 1979 report by the Subcommittee on Oversight and Investigations of the House Interstate and Foreign Commerce Committee (the Eckhardt Report), Section 7003 was designed to provide the EPA Administrator with "overriding authority" to respond to situations involving a substantial threat to public health or the environment regardless of other remedies provided in RCRA.

Since 1979, the Department of Justice, on behalf of EPA, has filed approximately 90 Section 7003 actions. (One of the first of these was against the companies responsible for the improper disposal at Love Canal.) Yet, despite its extensive use, the wording of Section 7003 was not free from ambiguity, and a number of courts have ruled that its reach is limited.

Taken together, these adverse rulings held that a Section 7003 action could not be used to compel a non-negligent offsite generator to help in the clean-up of a waste site where its wastes were disposed of. Although other court decisions gave Section 7003 a much broader reading, Congress was worried that the Government's principal enforcement tool was being misinterpreted and seriously weakened. Section 7003 was rewritten and, although the revisions were labeled a simple "clarification" of existing law, the House Energy and Commerce Committee left no doubt that it intended to legislatively overrule the adverse holdings:

"These amendments are intended to clarify the breadth of Section 7003 as to the persons, conditions and acts it covers. . . . [A]nyone who has contributed to the creation, existence or maintenance of an imminent and substantial endangerment is subject to the equitable power of Section 7003, without regard to fault or negligence. Such persons include, but are not limited to, past and present generators (both off-site and on-site) . . . past and present owners and operators of waste treatment storage or disposal facilities and past and present transporters . . . Thus, for example, non-negligent generators whose wastes are no longer being deposited or dumped at a particular site may be ordered to abate the hazard to health or the environment posed by the leaking of wastes they once deposited or caused to be deposited on the site."

Having made sure that the imminent and substantial endangerment provision could be used as originally intended, Congress also provided to individual

citizens the right to force clean-up of hazardous waste sites. Thus, as a result of a major expansion of the existing citizens suit provision (7002), any person may bring an action to abate an imminent and substantial endangerment involving the management or disposal of solid or hazardous waste.

Although Congress placed substantial enforcement authority in the hands of ordinary citizens, it took steps to assure that the citizens suit provision was not used to prevent or delay Superfund clean-ups or interfere with ongoing RCRA enforcement efforts. Therefore, a citizen may not sue 1) where EPA has commenced, and is diligently prosecuting, actions under Section 7003 or Section 106 of Superfund; 2) where the State has commenced and is diligently prosecuting an imminent and substantial endangerment action under Section 7002; 3) while the Administrator or the State is actually engaging in a removal action under Section 104 of Superfund or has incurred costs to initiate a Remedial Investigation/Feasibility Study (RIFS) under Section 104 of Superfund and is diligently proceeding with a remedial action; and 4) where the Administrator has obtained a court order (including a consent decree) or issued an administrative order under Section 106 of Superfund, or Section 7003 pursuant to which a responsible party is diligently conducting a removal action, RIFS or proceeding with a remedial action.

Moreover, citizen suits cannot be used to challenge the siting or permitting of hazardous waste facilities.

Conclusion

The numerous and, in some cases, drastic revisions that Congress made to RCRA resulted primarily from a sense of frustration with EPA's apparent lack of progress in addressing the myriad problems associated with hazardous waste management. The 1984 amendments were also a manifestation of Congress' clear sense of purpose in wanting to steer a radically different course—and at much greater speed. Whether this bold experiment works remains to be seen. EPA appears to be committed to carrying out both the letter and spirit of the Hazardous and Solid Waste Amendments of 1984, but no one should underestimate the magnitude of the task.

Bud Ward is Editor of *The Environmental Forum*, a monthly magazine published by the Environmental Law Institute (ELI) in Washington, D.C. Christopher Harris, previously the lead House counsel on the 1984 Hazardous and Solid Waste Amendments, is an attorney with the law firm of Zuckert, Scoutt, Rasenberger and Johnson in Washington, D.C. Ward and Harris are coauthors of *Hazardous Waste—Confronting the Challenge*, a new book to be published this spring by ELI.

presidential documents

[3195-01-M]

Title 3—The President

Executive Order 12088

October 13, 1978

Federal Compliance With Pollution Control Standards

By the authority vested in me as President by the Constitution and statutes of the United States of America, including Section 22 of the Toxic Substances Control Act (15 U.S.C. 2621), Section 319 of the Federal Water Pollution Control Act, as amended (33 U.S.C. 1323), Section 1447 of the Public Health Service Act, as amended by the Safe Drinking Water Act (42 U.S.C. 300j-6), Section 118 of the Clean Air Act, as amended (42 U.S.C. 7418(b)), Section 4 of the Noise Control Act of 1972 (42 U.S.C. 4903), Section 6001 of the Solid Waste Disposal Act, as amended (42 U.S.C. 6961), and Section 301 of Title 3 of the United States Code, and to ensure Federal compliance with applicable pollution control standards, it is hereby ordered as follows:

1-1. *Applicability of Pollution Control Standards.*

1-101. The head of each Executive agency is responsible for ensuring that all necessary actions are taken for the prevention, control, and abatement of environmental pollution with respect to Federal facilities and activities under the control of the agency.

1-102. The head of each Executive agency is responsible for compliance with applicable pollution control standards, including those established pursuant to, but not limited to, the following:

- (a) Toxic Substances Control Act (15 U.S.C. 2601 *et seq.*).
- (b) Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 *et seq.*).
- (c) Public Health Service Act, as amended by the Safe Drinking Water Act (42 U.S.C. 300f *et seq.*).
- (d) Clean Air Act, as amended (42 U.S.C. 7401 *et seq.*).
- (e) Noise Control Act of 1972 (42 U.S.C. 4901 *et seq.*).
- (f) Solid Waste Disposal Act, as amended (42 U.S.C. 6901 *et seq.*).
- (g) Radiation guidance pursuant to Section 274(h) of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2021(h); see also, the Radiation Protection Guidance to Federal Agencies for Diagnostic X Rays approved by the President on January 26, 1978 and published at page 4377 of the *FEDERAL REGISTER* on February 1, 1978).
- (h) Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401, 1402, 1411-1421, 1441-1444 and 16 U.S.C. 1431-1434).
- (i) Federal Insecticide, Fungicide, and Rodenticide Act, as amended (7 U.S.C. 136 *et seq.*).

1-103. "Applicable pollution control standards" means the same substantive, procedural, and other requirements that would apply to a private person.

1-2. *Agency Coordination.*

1-201. Each Executive agency shall cooperate with the Administrator of the Environmental Protection Agency, hereinafter referred to as the Adminis-

trator, and State, interstate, and local agencies in the prevention, control, and abatement of environmental pollution.

1-202. Each Executive agency shall consult with the Administrator and with State, interstate, and local agencies concerning the best techniques and methods available for the prevention, control, and abatement of environmental pollution.

1-3. *Technical Advice and Oversight.*

1-301. The Administrator shall provide technical advice and assistance to Executive agencies in order to ensure their cost effective and timely compliance with applicable pollution control standards.

1-302. The administrator shall conduct such reviews and inspections as may be necessary to monitor compliance with applicable pollution control standards by Federal facilities and activities.

1-4. *Pollution Control Plan.*

1-401. Each Executive agency shall submit to the Director of the Office of Management and Budget, through the Administrator, an annual plan for the control of environmental pollution. The plan shall provide for any necessary improvement in the design, construction, management, operation, and maintenance of Federal facilities and activities, and shall include annual cost estimates. The Administrator shall establish guidelines for developing such plans.

1-402. In preparing its plan, each Executive agency shall ensure that the plan provides for compliance with all applicable pollution control standards.

1-403. The plan shall be submitted in accordance with any other instructions that the Director of the Office of Management and Budget may issue.

1-5. *Funding.*

1-501. The head of each Executive agency shall ensure that sufficient funds for compliance with applicable pollution control standards are requested in the agency budget.

1-502. The head of each Executive agency shall ensure that funds appropriated and apportioned for the prevention, control and abatement of environmental pollution are not used for any other purpose unless permitted by law and specifically approved by the Office of Management and Budget.

1-6. *Compliance With Pollution Controls.*

1-601. Whenever the Administrator or the appropriate State, interstate, or local agency notifies an Executive agency that it is in violation of an applicable pollution control standard (see Section 1-102 of this Order), the Executive agency shall promptly consult with the notifying agency and provide for its approval a plan to achieve and maintain compliance with the applicable pollution control standard. This plan shall include an implementation schedule for coming into compliance as soon as practicable.

1-602. The Administrator shall make every effort to resolve conflicts regarding such violation between Executive agencies and, on request of any party, such conflicts between an Executive agency and a State, interstate, or a local agency. If the Administrator cannot resolve a conflict, the Administrator shall request the Director of the Office of Management and Budget to resolve the conflict.

1-603. The Director of the Office of Management and Budget shall consider unresolved conflicts at the request of the Administrator. The Director shall seek the Administrator's technological judgment and determination with regard to the applicability of statutes and regulations.

1-604. These conflict resolution procedures are in addition to, not in lieu of, other procedures, including sanctions, for the enforcement of applicable pollution control standards.

1-605. Except as expressly provided by a Presidential exemption under this Order, nothing in this Order, nor any action or inaction under this Order, shall be construed to revise or modify any applicable pollution control standard.

1-7. *Limitation on Exemptions.*

1-701. Exemptions from applicable pollution control standards may only be granted under statutes cited in Section 1-102(a) through 1-102(f) if the President makes the required appropriate statutory determination: that such exemption is necessary (a) in the interest of national security, or (b) in the paramount interest of the United States.

1-702. The head of an Executive agency may, from time to time, recommend to the President through the Director of the Office of Management and Budget, that an activity or facility, or uses thereof, be exempt from an applicable pollution control standard.

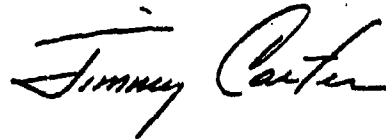
1-703. The Administrator shall advise the President, through the Director of the Office of Management and Budget, whether he agrees or disagrees with a recommendation for exemption and his reasons therefor.

1-704. The Director of the Office of Management and Budget must advise the President within sixty days of receipt of the Administrator's views.

1-8. *General Provisions.*

1-801. The head of each Executive agency that is responsible for the construction or operation of Federal facilities outside the United States shall ensure that such construction or operation complies with the environmental pollution control standards of general applicability in the host country or jurisdiction.

1-802. Executive Order No. 11752 of December 17, 1973, is revoked.



THE WHITE HOUSE,
October 13, 1978.

[FR Doc. 78-29406 Filed 10-13-78; 3:40 pm]

EDITORIAL NOTE: The President's statement of Oct. 13, 1978, on signing Executive Order 12088 and his memorandum for the heads of departments and agencies, dated Oct. 13, 1978, on Federal compliance with pollution control standards are printed in the Weekly Compilation of Presidential Documents (vol. 14, no. 41).



OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D.C. 20301

13 MAY 1980

MANPOWER,
RESERVE AFFAIRS
AND LOGISTICS

Defense Environmental Quality Program Policy Memorandum
(DEQPPM No. 80-5)

MEMORANDUM FOR DEPUTY FOR ENVIRONMENT, SAFETY AND OCCUPATIONAL
HEALTH, OASA (IL&FM)
DEPUTY UNDER SECRETARY OF THE NAVY
DEPUTY FOR ENVIRONMENT AND SAFETY, SAF/MIQ
DIRECTOR, DEFENSE LOGISTICS AGENCY

SUBJECT: Department of Defense Hazardous Material Disposal Policy

PURPOSE: This is to provide Department of Defense (DoD) policy guidance on the disposal of hazardous materials. This memorandum supercedes DEQPPM 79-4, "Department of Defense Hazardous Material Disposal Policy," of December 17, 1979.

BACKGROUND: DoD possesses large quantities of hazardous materials, both new items and waste products, that must be disposed of in an environmentally acceptable manner. The Resource Conservation and Recovery Act of 1976 (RCRA) and the Toxic Substance Control Act of 1976 (TSCA) require that DoD update its disposal policy regarding hazardous materials.

In 1974, DoD designated the Defense Supply Agency, subsequently renamed the Defense Logistics Agency (DLA), to be responsible ". . . for the disposition of items identified as unsalable because the material has no sales value . . . (except) refuse and trash . . . (and) items . . . restricted by law or military regulation." Some of the materials reassigned to DLA were hazardous, but the overall hazardous material disposal responsibility was not specifically addressed in the 1974 policy.

In December of 1979, the Deputy Assistant Secretary of Defense, Energy, Environment and Safety (DASD-EES), in coordination with the Deputy Assistant Secretary of Defense, Supply, Maintenance, and Transportation (DASD-SM&T), issued Defense Environmental Quality Program Policy Memorandum 79-4 (DEQPPM 79-4) which provided urgently needed guidance on hazardous material disposal. After the policy was issued, representatives of the military departments, DLA, and OASD(MRA&L) agreed to refine further DoD policy. This DEQPPM 80-5 includes the refinements which those representatives recommended. For purposes of this memorandum, the term DoD components refers to the military departments and all defense agencies except disposal operating entities of DLA. Other terms used in this policy are defined in Tab A.

POLICY: DoD policy is to dispose of hazardous materials in an environmentally acceptable manner:

- DLA is designated the responsible agency within DoD for worldwide disposal of all hazardous materials, except for those categories of materials specifically designated for DoD component disposal (Tab B). Specific DLA responsibilities for disposal of assigned hazardous materials are in Tab C.

- DoD components shall dispose of those categories of hazardous materials listed in Tab B. In addition, the DoD component shall support DLA disposal actions as specified in Tab D.

- The DASD(EES), in coordination with DASD(SM&T) and other OSD offices as necessary, shall formulate, implement, and monitor policy for disposal of hazardous material and shall decide any unresolved issues which may develop, including the reassignment of responsibility for disposal of specific categories of hazardous material when circumstances warrant.

- No other changes are made to the respective disposal mission responsibilities of the DoD components or DLA.

IMPLEMENTATION: This memorandum is effective immediately and should be implemented as rapidly as possible.

- DLA shall make optimum use of existing disposal capabilities and resources.

- DLA shall program for the additional resources required to discharge its responsibilities under this memorandum.

- DLA is directed to organize immediately and chair an inter-service task group to plan actions and milestones for the full implementation of this policy and submit their report to DASD(EES) within 120 days from the date of this memorandum.

- The task group will develop and promulgate a hazardous materials data call to identify current and projected hazardous materials disposal workload, as well as the actions and methodology employed to dispose of those materials. The task group should also identify, in as much detail as possible, the technical support and assistance which can be provided DLA in its efforts to insure expeditious disposal of hazardous materials in an environmentally safe manner. The task group will identify those additional resource requirements which, if made available to DLA, can be effectively applied to expedite hazardous materials disposal during FY 80 and FY 81.

SIGNED

Paul H. Riley
Deputy Assistant Secretary of Defense
(Supply, Maintenance and Transportation)

SIGNED

George Marienthal
Deputy Assistant Secretary
of Defense
(Energy, Environment and Safety)

Enclosures:

- Tab A - Definitions
- Tab B - Materials Assigned to DoD Components
for Disposal
- Tab C - Responsibilities of DLA for Disposal
of Assigned Hazardous Materials
- Tab D - Responsibilities of the DoD Components
in Support of the DLA Disposal of Hazardous
Materials.

MR/Reading/EES

P. Haviland/ds/57820/6May80

DEFINITIONS

Material is hazardous when, because of its quantity, concentration, or physical, chemical, or infectious characteristics, it may: (a) cause, or significantly contribute to, an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed.

For the purposes of this memorandum, hazardous materials do not include those radioactive materials that the Nuclear Regulatory Commission controls. Licensees shall be responsible for the disposal of those materials per 10 CFR 20.

Hazardous material may be defined as personal property consisting of items, scrap, and waste:

Items - All unused, used, or contaminated property or combinations of property, (unused, used, mixed or contaminated) which can be identified by a national stock number, manufacturer's part number, military specification number, or locally purchased property with a locally applied stock number. Also, that property which by military regulation requires application of a local stock number prior to disposal.

Scrap - Used or unused property which has no value except for basic material content.

Waste - Used or unused property, residues, by-products, sludges, and other materials, which have no known utility and must, therefore, be discarded.

Conforming storage is a facility or location which conforms to regulations of the Environmental Protection Agency and other regulatory authorities governing the storage of hazardous materials.

The generating activity is an organization or element authorized to turn-in property to the Defense Property Disposal Service.

**Materials Assigned to DoD
Components for Disposal**

DoD components shall be responsible for disposal of the following categories of hazardous materials which have not been assigned to DLA:

1. Toxicological, biological, radiological, and lethal chemical warfare materials which, by U.S. law, must be destroyed. Disposal of the by-products of such material is the responsibility of the DoD component with assistance from DLA.

2. Material which cannot be disposed of in its present form due to military regulations, e.g., consecrated religious items and cryptographic equipment.

3. Municipal type garbage, trash, and refuse resulting from residential, institutional, commercial, agricultural, and community activities, which the facility engineer or public works office routinely collect.

4. Contractor generated materials which are the contractor's responsibility for disposal under the terms of the contract.

5. Sludges resulting from municipal type wastewater treatment facilities.

6. Sludges and residues generated as a result of industrial plant processes or operations.

7. Refuse and other discarded materials which result from mining, dredging, construction, and demolition operations.

8. Unique wastes and residues of a non-recurring nature which research and development experimental programs generate.

Responsibilities of DLA
for Disposal of
Assigned
Hazardous Materials

Specific DLA responsibilities in this area shall include, but not necessarily be limited to, the following:

1. Accomplish documentation for DLA disposal actions as required under laws and regulations.

2. Initiate contracts or agreements for disposal.

3. Accept accountability for all hazardous materials except those categories specifically excluded in Tab B, which have been properly identified, packaged, labeled, and certified in conformance with established criteria.

4. Accept custody of hazardous materials within the following guidelines:

- If DLA possesses conforming storage at the defense property disposal offices (DPDO), DLA will accept physical custody at the time it accepts accountability.

- If DLA does not possess conforming storage at the DPDO, and the generating activity has conforming storage in support of mission requirements, the generating activity will retain physical custody, and DLA will accept accountability.

- In those instances where neither DLA nor the generating activity possess conforming storage, the activity with the "most nearly" conforming storage will accept or retain physical custody and DLA will accept accountability.

- DLA will be responsible for the long term programming of military construction funding for conforming storage in support of its disposal mission.

- If DLA and the component involved cannot mutually agree on the best procedure for storage and handling pending final disposal, the issue shall be referred at once to OASD(MRA&L) for resolution.

5. Provide any required repackaging or handling of hazardous materials subsequent to acceptance of accountability from the generating activity.

6. Establish an inventory control system for the types, quantities, and locations of available hazardous materials for which DLA is responsible in the event that some other activity might be able to use a particular material as a resource.

7. Provide feedback to the military departments and defense agencies on the costs associated with disposal in order that this information might serve as an economic incentive to minimize waste generation.

8. Contract for disposal technology not available in-house or from the DoD components.

9. Minimize environmental risks and costs associated with extended care, handling, and storage of hazardous materials by accomplishing disposal within a significantly compressed disposal cycle. Initiate actions and projects within DoD and in conjunction with federal civil agencies and industry to realize this objective and expedite final disposal.

10. Devise a system by which the time of turn-in will be highly visible on hazardous materials to insure proper application of resources to dispose of these materials. DLA should insure that sufficient disposal capability is programmed to preclude extended delays in the hazardous materials disposal process.

11. Establish and maintain an analysis and information distribution capability to:

- Evaluate the impact and applicability of current technological advances on DoD hazardous material disposal procedures and inform the DoD components of these developments on a continuing basis.

- Assure that the DoD components are apprised, on a continuing basis, of any federal, state, regional, and local regulations being developed to control hazardous material disposal.

12. Become the DoD focal point to recommend to DASD(EES) matters of policy and guidance for hazardous material disposal.

13. Establish procedures relative to assigned responsibility for hazardous material disposal. Unresolved issues will be forwarded to OASD(MRA&L) with appropriate comments.

14. DLA shall program to carry out their responsibilities through normal budgeting channels.

**Responsibilities of the DoD Components
in Support of the DLA Disposal of
Hazardous Materials**

1. Where feasible, minimize quantities of hazardous waste through resource recovery, recycling, source separation, and acquisition policies.
2. Provide available technical and analytical assistance, including R&D support, to DLA to accomplish disposal, if requested.
3. Provide all available information to DLA, as required, to complete environmental documentation, e.g., environmental impact statement associated with disposal.
4. Properly identify, package, label, and certify conformance with established criteria prior to transfer of accountability to DLA. Subsequent repackaging or handling is the responsibility of DLA.
5. DoD components will retain custody of hazardous materials within the following guidelines:
 - If DLA does not possess conforming storage at the DPDO, and the generating activity has conforming storage in support of mission requirements, the generating activity will retain physical custody, and DLA will accept accountability.
 - In those instances where neither DLA nor the generating activity possesses conforming storage, the activity with the "most nearly" conforming storage will accept/retain custody.
 - If DLA and the component involved cannot agree on the best procedure for storage and handling pending final disposal, the issue will be referred at once to OASD(MRA&L) for resolution.
 - When a DoD component retains custody of a hazardous material, this hazardous material shall be kept on the accountable records of DLA.
6. When requested, the DoD components will assist DLA by providing information and comments on federal, state, regional, and local regulations being developed to control hazardous material disposal, e.g., ability of particular installations to comply and impact on DoD. The DoD components will alert DLA to any local situation which could impact on hazardous materials disposal.
7. DoD components shall program to carry out their responsibilities through normal budgeting channels.



MANPOWER,
RESERVE AFFAIRS
AND LOGISTICS

APPENDIX 1.4
OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE

WASHINGTON, D C 20301

21 OCT 1980

DEFENSE ENVIRONMENTAL QUALITY PROGRAM POLICY MEMORANDUM (DEQPPM) 80-8

MEMORANDUM FOR ASSISTANT SECRETARY OF THE ARMY (IL&FM)
ASSISTANT SECRETARY OF THE NAVY (MRA&L)
DEPUTY UNDER SECRETARY OF THE NAVY
ASSISTANT SECRETARY OF THE AIR FORCE (MRA&I)
ASSISTANT SECRETARY OF THE AIR FORCE (RD&L)
DIRECTORS OF DEFENSE AGENCIES

SUBJECT: RCRA Hazardous Waste Management Regulations

PURPOSE: This is to provide additional policy guidance to implement within the Department of Defense the hazardous waste management regulations of the Resource Conservation and Recovery Act (RCRA) of 1976.

BACKGROUND: On May 19, 1980, the Environmental Protection Agency (EPA) published implementing instructions to Subtitle C of RCRA which established a federal program to provide comprehensive regulation of hazardous waste. When fully implemented, this program will provide "cradle-to-grave" regulation of hazardous waste.

The Department of Defense is an entity responsible for determining when a material becomes a waste subject to RCRA Regulations. Applying the criteria set forth in Subparts C and D of 40 CFR Part 261 further qualifies the waste as hazardous at which point the RCRA Regulations become effective. Also, RCRA establishes standards for generators and transporters of hazardous waste that will ensure proper record-keeping and reporting, the use of a manifest system to track shipments of hazardous waste, the use of proper labels and containers, and the delivery of the waste to properly permitted treatment, storage, and disposal facilities. To ensure that these facilities are designed, constructed, and operated in a manner which protects human health and the environment, the regulations promulgate technical, administrative, monitoring, and financial standards for them. EPA will use these independently enforceable standards to issue permits to owners and operators of facilities.

Also in May, 1980, Defense Environmental Quality Program Policy Memorandum 80-5 was published to provide DoD policy on the disposal of hazardous materials. That policy designates the Defense Logistics Agency as responsible for the disposal of all hazardous materials except those that specifically remain the other DoD components' responsibilities.

POLICY: The DoD policy is:

- To limit the generation of hazardous waste through alternative procurement practices and operational procedures that are attractive environmentally yet are fiscally competitive,
- To reutilize, reclaim, or recycle resources where practical and thus conserve on total raw material usage,
- To exhaust all other actions mandated by Federal statutes or regulations prior to identifying the material as discardable,
- To dispose of hazardous waste in an environmentally acceptable manner according to the disposal policy established in DEQPPM 80-5,
- To implement within DoD the hazardous waste management regulations that EPA published under Subtitle C of RCRA or that states enact under EPA authorization,
- To consider all unused hazardous materials as not regulated under RCRA until a decision is made to discard them, and,
- To insure that all used hazardous materials are safely handled, accounted for, and controlled by internal DoD documentation. The internal controlling documentation will be applied to all movement among DoD activities and will reflect all data elements prescribed for auditing purposes and for shipping manifests as required by EPA or the states. The DoD component/entity assigned disposal responsibility by DEQPPM 80-5 will advise the using activities as to which "used" hazardous material must be controlled as a hazardous waste.

ACTION REQUIRED: DoD components will:

- Reduce hazardous waste generation to the maximum extent practical,
- Reutilize, reclaim, or recycle resources where practical, and
- Implement EPA hazardous waste management regulations.

As part of that implementation, any DoD installation that generates or transports hazardous waste or owns or operates a facility that treats, stores, or disposes of hazardous waste will notify EPA regional administrators as required. Each installation will obtain one EPA identification number. That identification number will be used for all subsequent reports and permit applications required for the installation.

Also, any installation which owns, operates, or proposes to own or operate a facility that treats, stores, or disposes of hazardous waste will apply for a permit from EPA or the state. That application is in two parts:

- Part A, which defines the process to be used, the design capability, and the hazardous waste to be handled, must be submitted by November 19, 1980.
- Part B, which contains more detailed information intended to establish that the facility can meet the technical standards that RCRA promulgated, must be submitted at a date that the regional administrator sets.

The installation commander will sign the permit application as the facility owner, and the operational manager of the permitted facility will sign the permit application as the operator. DLA or other tenants will sign as operation manager for all functions for which they have been assigned responsibility under DEQPPM 80-5. Each installation that requires a permit will submit one EPA Form 3510-1 for the installation (Form 1 - General Information) and an EPA Form 3510-3 for each permitted facility (Form 3 - Hazardous Waste Permit Application).

Implementation of the comprehensive hazardous waste management program mandated by RCRA requires maximum cooperation of all activities on an installation. The installation commander is responsible to ensure compliance with all RCRA requirements for the installation. The installation commander is responsible to notify, to apply for permits, and to report to EPA or the state, as required, for all installation activities, including tenants. The individual facility operational managers are accountable for conducting their activities in accordance with RCRA. Those facility managers, including supporting property disposal activities and tenant activities, will provide necessary documentation to the installation commander for permit application, will provide to the installation commander reports required by EPA or the state, and will ensure compliance with RCRA regulations and permit requirements at that facility. All reports to EPA or the state will be co-signed by the installation and facility operator or their designated officials.

For facilities that DoD owns but does not operate, the DoD component that owns the facility is responsible as the owner for purposes of the permit. For example, on an Army government-owned, contractor-operated plant, the contractor may be the applicant for the permit, but the local Army commanding officer is still responsible to ensure compliance.

DoD components will use the Disposal Turn In Document (DTID) or a bill of lading, as appropriate, modified to meet the EPA requirements, for the shipping manifest. The shipping activity, either servicing property disposal activity or facility operator, will manifest any shipment of hazardous waste off the installations in accordance with RCRA. The responsibility for tracking the manifest terminates at the permitted facility destination for that shipment; however, the shipper must obtain a copy of the completed manifest to show arrival at that destination. For shipments among DoD components, whether on the same installation or between installations, the turn-in activity's responsibility terminates upon receipt of a signed copy of the Disposal Turn In Document (DTID) or the govern-

ment bill of lading which serves as the internal manifest between the generator, the servicing DPDO, or other permitted receiver.

Each DoD component will take immediate action to identify all resources required to achieve full compliance with EPA and state regulations. Those resources will then be addressed, within program decision memorandum approved overall component resource levels, in future budget submissions.

An installation that requires permits for more than one program (RCRA, Safe Drinking Water Act, Clean Water Act, and Clean Air Act programs) is encouraged to consolidate its application, if possible, under EPA's consolidated permit program.

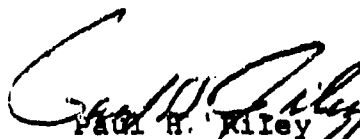
In special circumstances, and where it is mutually agreed among the installation, tenant, and EPA/State, exceptions to the above policies will be documented by the DoD component concerned and forwarded to DASD(EES) for approval.

The DASD(EES), in coordination with DASD(SM&T) and other OSD offices as necessary, shall monitor policy implementation for RCRA hazardous waste management, and shall decide any unresolved issues which may develop.

This memorandum is effective this date. Progress toward implementation of this memorandum and the RCRA hazardous waste regulations will be included in the environmental management-by-objective (MBO) semi-annual reports.



George Marienthal
Deputy Assistant Secretary of Defense
(Energy, Environment and Safety)



Paul H. Riley
Deputy Assistant Secretary of Defense
(Supply, Maintenance and Transportation)

CHAPTER XXI

HAZARDOUS PROPERTY MANAGEMENT

A. GENERAL

1. The purpose of this chapter is to provide DoD installations and DLA personnel with guidance for handling, processing, and disposing of hazardous property, in accordance with applicable environmental and other pertinent laws and regulations.

2. The DoD policy is to store and dispose of all hazardous property in an environmentally acceptable manner in accordance with applicable environmental and other pertinent laws and regulations.

3. For definitions see Attachment I and Chapter III, this manual.

B. RESPONSIBILITIES

1. DoD installation responsibilities are as follows:

a. Where feasible, minimize quantities of hazardous property through resource recovery, recycling, source separation, and acquisition policies.

b. Provide available technical and analytical assistance, including research and development support, to DLA to accomplish disposal, if requested.

c. Provide all available information to DLA, as required, to complete environmental documentation; e.g., environmental impact statements associated with disposal.

d. Properly identify, package, label and certify conformance with established environmental and transportation criteria prior to transfer of accountability for hazardous property to DLA.

e. When requested, assist DLA by providing information and comments on federal, state, regional, and local regulations being developed to control hazardous property disposal; e.g., ability of particular installation to comply and impact on DoD. Alert DLA to any local situation which could impact hazardous property disposal.

f. Retain physical custody of hazardous property within the guideline provided in paragraph C, this chapter.

g. Provide for disposal of the following categories of hazardous property:

(1) Toxicological, biological, radiological, and lethal chemical warfare materials which, by U.S. law, must be destroyed. Disposal of the by-products of such

material is the responsibility of the DoD installation with assistance from DLA.

(2) Material which cannot be disposed of in its present form due to military regulations; e.g., Ammunition, Explosives and Dangerous Articles (AEDA), controlled medical items. This category would include those instances where military regulations require the obliteration of all markings that could relate an excess material to its operational program. Once the appropriate actions are taken to meet the military regulation, the resulting material could then be turned in to the servicing DPDO.

(3) Municipal-type garbage, trash, and refuse, resulting from residential, institutional, commercial, agricultural, and community activities, which can be disposed of in a state or locally permitted sanitary landfill.

(4) Contractor generated materials which are the contractor's responsibility for disposal under the terms of the contract.

(5) Sludges resulting from municipal-type waste-water treatment facilities.

(6) Sludges and residues generated as a result of industrial plant processes or operations. Properly identified industrial process sludges and residues which are not commingled or a product of an industrial waste treatment facility are the responsibility of DLA. DLA does not take sludges and residues from waste water treatment facilities. DLA does take sludges and residues from industrial processes that have not been commingled. For example, sludges and residues from industrial process "A" must be collected and stored separately from sludges and residues resulting from industrial process "B". Each process may result in sludges and residues that contain a mixture of ingredients and contaminants but the sludges and residues from each process must be collected and stored separately and not commingled.

(7) Refuse and other discarded material which result from mining, dredging, construction, and demolition operations.

(8) Unique wastes and residues of a nonrecurring nature which research and development experimental programs generate.

2. The DLA responsibilities are as follows:

a. Accomplish documentation (including records, for DLA disposal actions as required under applicable

environmental and other pertinent laws and regulations.

b. Initiate contracts or agreements for DLA disposal actions.

c. Accept accountability for all hazardous property, except those categories under responsibility of DoD installations (paragraph B1 above) which have been properly identified, packaged, labeled, and certified in accordance with environmental and transportation laws and regulations.

d. Accept sludges and residues from industrial processes that have not been commingled, e.g., sludges and residues from industrial process "A" must be collected and stored separately from sludges and residue resulting from industrial process "B".

e. Accept custody of hazardous property within the guidelines provided in paragraph C, this chapter.

f. Program for construction of storage facilities in support of the DLA disposal mission.

g. Provide any required repackaging or handling of hazardous property subsequent to acceptance of accountability from the turn-in activity.

h. Establish an inventory control system for the types, quantities, and locations of available hazardous property for which DLA is responsible in the event that some other activity might be able to use particular property as a resource.

i. Provide an economic incentive for DoD installations to segregate and minimize waste generation by:

(1) Providing feedback to military departments and defense agencies on the costs associated with destruction of HW.

(2) Providing 100 percent reimbursement to DoD installations with qualified recycling programs for hazardous wastes sold by DLA for recycling in accordance with DoD policy.

j. Contract for disposal technology not available within the DoD.

k. Minimize environmental risks and costs associated with the extended care, handling, and storage of hazardous property by accomplishing disposal within a significantly compressed disposal cycle. Initiate actions and projects within DoD and in conjunction with federal, state and local agencies and industry to realize this objective and expedite final disposal.

L. Operate a system to ensure that sufficient disposal capability is programmed to preclude extended delays in the hazardous property disposal process.

m. Maintain an analysis and information distribution capability of current technological advances on DoD hazardous property disposal procedures and advise DoD installations of such developments on a continuing basis. Additionally, ensure that DoD installations are apprised of any federal, state, regional, and local regulations being developed to control hazardous property disposal.

n. Serve as the DoD focal point to recommend to OASD matters of policy and guidance for hazardous property disposal.

o. Establish procedures relative to assigned responsibility for hazardous property disposal. Unresolved issues will be forwarded to OASD with appropriate comments.

C. RESERVED

D. TURN-IN PROCEDURES (GENERAL)

DoD installations and DLA are responsible for compliance with environmental and other pertinent laws and regulations. In order to ensure environmental compliance turn-in activities and DPDOS will:

1. Preplan, schedule, and coordinate hazardous property turn-ins.

2. Process turn-ins of hazardous property as follows:

a. Identification

(1) NSN-identified hazardous property.

(a) The turn-in activity will provide the following upon turn-in of NSN-identified hazardous property to the DPDO:

1. Valid NSN.

2. Noun name as cataloged in the supply system.

3. Chemical name of hazardous contaminants and noun name of nonhazardous contaminants.

4. Amount of hazardous and nonhazardous contaminants based on user's knowledge or testing of the item expressed in a range of content by percentage or parts per million as applicable.

(b) When necessary, the DPDO will:

1. Search HMIS and/or other data sources for chemical names of hazardous components.

2. Search HMIS for transportation and other data as required.

3. Contact manufacturer for data as required.

(2) LSN/FSC-identified property.

(a) The turn-in activity will provide the following for turn-in of hazardous property to the DPDO:

1. Chemical name of hazardous components.
2. Chemical name of hazardous contaminants and noun name of nonhazardous contaminants.
3. Amounts of hazardous and nonhazardous contaminants based on user's knowledge or testing of the item, expressed in a range of content by percentage or parts per million as applicable.

(b) The DPDO will:

1. Accept accountability of property identified in the above manner.
2. Accept physical custody in accordance with paragraph C, this chapter.
3. Assign proper DoT shipping description to item received from on-site or for property that is received in-place and is not transported over public highways.
4. Assist turn-in activity in determining proper identification as capabilities permit.
5. Reject turn-in when proper identification in accordance with the above is not provided.

(3) PCBs. An analysis of PCB concentration as determined by a scientifically acceptable analytical method will accompany the DTID unless the property has a manufacturer's label or nameplate that indicates the presence of PCBs; e.g., generic or commercial name. The analysis will indicate the amount of PCB in parts per million (ppm) or in the following ranges:

- a. Less than 50 ppm
- b. 50-499 ppm
- c. 500 ppm or more

Individual analysis is required for each item. Items such as capacitors which do not have sampling or servicing parts and are sealed by the manufacturer and are suspected to contain PCBs will be turned in as PCB items (500 ppm and over) without analysis. DPDS may accept batch testing results of mineral oil dielectric on a case-by-case basis. However, approval for batch testing will be obtained from DPDS prior to turn-in.

b. Packaging.

(1) Property turned in to the DPDO must be in containers that are non-leaking and safe to handle.

The containers must be able to withstand normal handling or the turn-in will be rejected.

(2) DoT specified containers are required for storage and movement of hazardous wastes. These wastes may also be accumulated in bulk in RCRA permitted facilities.

(3) DoT specified containers are not required for turn-in to the DPDO of anything other than the hazardous wastes. The transporting agency does have a responsibility to comply with DoT requirements for transport over public highways.

(4) When hazardous property turned in for disposal is packaged in the original military containers, the turn-in activity will provide the DPDO with a certification as to the true condition/reliability of the containers. The certification will be placed in Block Y of the DTID by the turn-in activity and will contain one of the following statements:

(a) Packaged in accordance with DoT 49 CFR 170-189.

(b) Packaging equals/exceeds DoT 49 CFR 170-189.

(c) Packaging is substandard to DoT 49 CFR 170-189 (this is not acceptable for hazardous waste "HW" or off-site hazardous property turn-in).

(5) DoD property in foreign countries or territories shall be packaged in accordance with the host country's environmental laws and/or status of foreign agreements.

c. Labeling.

(1) Hazardous property will be labeled in conformance with established environmental and transportation laws and regulations.

(2) PCB marking requirements are as prescribed by the EPA in 40 CFR 761.45. Items containing 50 ppm or more PCB must be marked, with the exception of transformers. Only PCB transformers, i.e., 500 ppm or more PCB, must be marked.

d. Disposal Turn-In Document (DTID).

(1) All property turned in to the DPDO will be done so with a properly prepared DTID. Standard procedures for preparation of a DTID are found in DoD 4140.17-M MILSTRIP. In addition, insert "HM" in block C if turn-in is hazardous material or "HW" if hazardous waste.

(2) The DTID will be modified to satisfy internal DoD auditing requirements. Where they exist, State/EPA required shipping manifests will be used in addition to the modified DTID for transporting haz-

XXI-3

ardous wastes. Information required on the State/EPA manifest must be completed by the turn-in activity when transporting hazardous wastes off-site and over public highways to a servicing DPDO.

(a) Block A - "Shipped From": add telephone number and EPA identification number. Installations qualifying as RCRA defined "small quantity generators" will enter "small generator exclusion" in lieu of the EPA identification number.

(b) Block B - "Ship To": add telephone number and EPA identification number.

(c) Block U - "Freight Classification Nomenclature": add Hazard Class (maximum 18 alpha characters) and six character (8 alpha, 4 numeric) identification number as shown in DoT 49 CFR 178.

(d) Blocks W-X.

1. For non-NSN hazardous waste items enter the word 'waste' and the item's proper shipping name as shown in DoT 49 CFR 178 and as much descriptive information as possible in Blocks W and X, and/or attach additional documentation with this data.

2. For NSN hazardous waste items Block W will be used for internal purposes and Block X must contain the word "waste" followed by the item's proper shipping name as shown in DoT 49 CFR 178.

(e) Block Y - Use this Block (in lieu of blocks AA through EE) for the deposit account number. Note: This is not an entry required on behalf of hazardous property documentation but a movement of data prescribed to permit use of the previously identified blocks for other purposes.

(f) Blocks AA and BB - Use these two blocks for the transporter's name and EPA identification number.

(g) Block CC - Have transporter (identified in Blocks AA and BB) sign and date for shipment received.

(h) Blocks DD, EE, FF and CC - Insert the following statement in these blocks (Note: Rubber stamped, typewritten or machine-produced copy required): "This is to certify that the above named materials are properly classified, described, packaged, marked and labeled, and are in proper condition for transportation according to the applicable regulations of DoT and EPA." To comply with RCRA, the turn-in activity will sign as the generator under the certification statement.

(i) Block 8. Enter DoT container classification.

(j) Block 9. Enter total quantity of hazardous waste by units of weight or volume (includes packaging).

(3) Block 8 of the DTID will be signed and dated by the DPDO and returned to the turn-in activity within 5 working days from receipt. The signed copy of the DTID will serve as valid receipt of accountability for the hazardous property by the DPDO.

E. TURN-IN PROCEDURES (SPECIFIC).

Detailed guidance governing turn-in as well as handling and processing of specific hazardous property is contained in Chapter VI, this manual.

F. IMPLEMENTATION OF RCRA.

1. Permits.

a. The installation commander is responsible to ensure compliance with all RCRA requirements for the installation. The installation commander is also responsible to notify, to apply for permits, and to report to EPA or the state, as required, for all installation activities, including tenants. Tenants are responsible for conducting their activities in accordance with RCRA and permit requirements at the facility. Tenants will provide necessary documentation, signed and completed, to the host for permit applications and for reports as required by EPA or the state. Submittals will be in the format required by the regulatory agencies.

b. The individual facility operational managers are responsible for conducting their activities in accordance with RCRA. Those facility managers, including tenants, will provide necessary documentation to the installation commander for permit applications, will provide to the installation commander reports required by EPA or the state, and will ensure compliance with RCRA regulations and permit requirements at that facility.

c. The installation commander will sign as the owner and the Defense Property Disposal Region Commander will sign as the operator.

2. Hazardous Waste Management Plan.

Implementation of the comprehensive hazardous waste management program, mandated by RCRA, requires maximum cooperation of all activities on an installation. The following guidance applies to development and implementation of a Hazardous Waste Management Plan:

a. The installation commander is responsible for developing and implementing a Hazardous Waste Management Plan to include all tenants on the in-

stallation. This plan shall identify and implement hazardous waste management actions required by RCRA. Tenants are responsible for providing input to the installation commander for their portion of the plan.

b. All tenants will comply with applicable portions of the Hazardous Waste Management Plan and ensure that internal operational procedures are consistent.

c. Reserved.

d. Reserved.

e. Reserved.

3. Manifesting.

When required by EPA and/or State RCRA derived regulations, a manifest will be prepared in addition to the modified DTID in accordance with paragraph D&D(s) above. The permit holder (installation commander) has primary responsibility for signing manifests, but may delegate signature authority. However, the DPDO will co-sign all manifests for shipments of hazardous property on DLA accountable records. In those instances where the permit holder delegates signature authority to the DPDO, only one signature will appear.

4. Record Keeping and Reporting.

Installations shall comply with federal and state hazardous waste record keeping and reporting requirements. Tenants shall submit reports required by the installation's Hazardous Waste Management Plan within time frames established by the installation commander. All reports to EPA or the state will be prepared in proper format by the operators and co-signed and submitted by the installation commander.

G. HAZARDOUS MATERIALS INFORMATION SYSTEM (HMIS)/HAZARDOUS MATERIALS TECHNICAL CENTER (HMTC)

1. DoD Instruction 6050.5, Hazardous Material Information System, assigns responsibilities for the establishment and use of a DoD hazardous material information system.

2. The HMIS is designed to support the major areas of health, safety, and transportation. This includes a wide range of data related to safety, health, transportation, and disposal of hazardous materials. Caution should be exercised in applying this information without the proper training and knowledge of procedures which are related to specific hazards. Data in this system is reference information and must be used in conjunction with, not in lieu of, procedures and regulatory documents. If there is any doubt about use of the safety and health information in the microfiche, the local health and safety staff should be contacted.

3. HMIS data are published on microfiche annually with quarterly cumulative updates. Items on the list are identified by NSN, Manufacturer, and Part Number (Trade Name) and are sequenced by NIIN.

4. HMTC is a DLA managed, contractor operated information source for technical information on safety, health, handling, transportation, disposal and environmental aspects of hazardous materials management. HMTC maintains a telephone response capability for DoD use in accessing this information.

Telephone numbers are: (800) 638-8958

(301) 468-8858

FTS (802) 468-8858

CHAPTER XXI

ATTACHMENT 1

DEFINITIONS

1. *Hazardous Property.* Includes material and waste having one or more of the following characteristics:

a. has a flashpoint below 200° F (93° C) closed cup, or is subject to spontaneous heating or is subject to polymerization with release of large amounts of energy when handled, stored, and shipped without adequate control;

b. has a Threshold Limit Value* equal to or below 1,000 ppm for gases and vapors, below 500 mg/m³ for fumes, and equal to or less than 30 mppcf or 10 mg/m³ for dusts (less than or equal to 2.0 fibers/cc greater than 5 micrometers in length for fibrous materials);

c. a single oral dose that will cause 50 percent fatalities to test animals when administered in doses of less than 500 mg per kilogram of test animal weight;

d. is a flammable solid as defined in DoT 49 CFR 173.150, or is an oxidizer as defined in DoT 49 CFR 173.151, or is a strong oxidizing or reducing agent with a half cell potential in acid solution of greater than ± 1.0 volt as specified in Latimer's table on the oxidation-reduction potential;

e. causes first-degree burns to skin in short-time exposure, or is systemically toxic by skin contact;

f. in the course of normal operations, may produce

dust, gases, fumes, vapors, mists, or smoke with one or more of the above characteristics;

g. produces sensitizing or irritating effects;

h. is radioactive;

i. the item has special characteristics which in the opinion of the manufacturer could cause harm to personnel if used or stored improperly;

j. the item is hazardous in accordance with OSHA 29 CFR 1910;

k. the item is hazardous in accordance with DoT 49 CFR 171-179 or the International Maritime Dangerous Goods Code of the International Maritime Organization (IMO) or the Dangerous Goods Regulations of the International Air Transport Association (IATA); or

l. is regulated by the Environmental Protection Agency under 40 CFR.

2. *Hazardous Wastes.* Property which is regulated as a hazardous waste under the Resource Conservation and Recovery Act and subsequent legislation, including state and local regulatory authorities.

3. *Hazardous Material.* Any hazardous property which is not a hazardous waste.

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XXI-A-1

APPENDIX

2.0 Selected Project References

- 2.1 Paint Removal Through Plastic Bead Blasting - The Sensible Way (Roberts, February 1985)
- 2.2 Effects of Plastic Bead Blasting for Paint Removal on Magnesium and Aluminum Aircraft Wheels (Seppi, 8 July 1985)
- 2.3 Plastic Bead Blast Paint Removal Booth (CH2M HILL, April 1985)
- 2.4 Abrasive Blast Cleaning, A Viable Alternative to Chemical Paint Stripping (Gardiner)

Paint Removal Through Plastic Bead Blasting—The Sensible Way

Robert A. Roberts

U.S. Air Force

Hill AFB, UT

Roberts, R. A. Paint Removal Through Plastic Bead Blasting - The Sensible Way, SAE Technical Paper Series 850712, 21st Annual Airline Plating and Metal Finishing Forum, Atlanta, Georgia, February 18-21, 1985.

ABSTRACT

Everyone who has something painted must usually have the paint removed from that item at some time during its life cycle. The following article covers one of the newest innovations devised for removing paint without contamination, hazards to personnel, the generation of waste or the consumption of toxic chemicals. Defined as PLASTIC BEAD BLASTING, the method provides an easy way of removing all types of paint in an average of one-tenth of the time previously taken to do the job with costly chemicals. A wide variety of equipment manufacturers are available with "off-the-shelf" equipment designed to do the job, and the plastic blasting media is available from the U.S. Plastics and Chemical Company. This new paint removal process is being hailed as the next "State-Of-The-Art" method for removal of paint from most aircraft and ground support equipment.

PLASTIC BLAST PAINT REMOVAL T H E R E I S A B E T T E R W A Y

We are living in a world which is slowly coming to its senses in the matters concerning chemical pollution. The Environmental Protection Agency is constantly tightening the restrictions on what can be used and how much, and it is just a matter of time before the cost of control will far exceed the cost of the materials used.

With that as the driving force, a decision was reached four years ago, by the Air Force, to develop a better way of removing paint from aircraft. The development and success of that project is as follows:

BACKGROUND

The technique most used to remove protective and decorative coatings from aircraft and ground support equipment is based on the chemical action of a stripping compound against primer and topcoat materials. The workability of this process depends on the number of successive coatings which are going to be removed, the length of time those coatings have been on the surface, and the compatibility of the coatings to the chemical stripper. If there are variables in any of these conditions, more than one type of paint stripper is required or a follow-up with hand sanding or buffing. This technique is expensive and time consuming, releases fumes into the working area which are undesirable, creates hazardous working conditions for the work force and results in removal products which are difficult and costly to dispose of without danger to the environment. Because of these adverse conditions and the continued accelerated hazardous chemical disposal costs, alternate methods of paint removal were required to meet the ever-tightening restrictions of the Environmental Protection Agency.

PROPOSAL

With all of the above in mind, the new method described herein covers the use of a relatively new product developed by the U.S. Plastics and Chemical Corporation, Putnam, Conn. The product is a soft (Mohs scale 3.5) plastic with sharp angular edge characteristics that have excellent cutting qualities for the removal of paint while still not being abrasive enough to damage metals. The actual work

process is sight oriented which establishes a very low training curve and allows personnel to become proficient in a short period of time. Stand-off distances can be varied to produce different removal rates, and in some cases, the top coats may be removed leaving the under coat primers in place. Carbon, grease, oil, and dirt deposits can easily be removed from difficult access areas, and any of the blast media left behind can be blown out with air, flushed with water or picked up with a vacuum system. No products of corrosion can be generated with the use of this blast media because it is totally inert.

ADVANTAGES

The advantages of using the Plastic Blast Media over other type of organic blasting compounds (walnut shells for example) is that it is more aggressive and therefore requires less operating pressure. The operational pressures recommended for blasting with the U.S.P.C angular plastic are 30 to 40 PSI at the nozzle. The plastic material does not break up readily and therefore produces very little dust. The reusability characteristics for recycling are very good, allowing the plastic material to be used continually until the screen size is categorized as dust. It can be stored without deterioration and can be dried out and used if it inadvertently gets wet, all without adverse effect on its ability to perform as designed. Because it is man made, it is constant in both size and hardness and does not vary from batch to batch. Standar blast equipment like that produced by CLEMCO, Pauli & Griffin, CAB Systems and Royce Mechanical Systems are now available for use. Arrowhead nozzles seem to provide the best blast patterns and the Goodyear Hi-Flex hoses are the easiest to use and are the least fatiguing.

OTHER METHODS

There are many mechanical paint removal proposals within the industry which are in the development stage. Laser, Flash Lamp, High Pressure CO2 and High Pressure water knives, to name a few. Each of these methods have proved that it is feasible to remove paint by mechanical means, but not always without damage to the substrate. The basic problem with these proposals is that there is considerable time and money required to develop them to a usable category, and the luxury of that time is really not available. The Proposed

Plastic Blasting method is available now, the equipment is categorized as "off the shelf" and the function of blast removal of paint from aircraft surfaces is already approved by both the Air Force and Navy. This plastic blast process will not only fill the "five year" development gap which the other methods need to become operational, but will save hundreds of millions of dollars while it is doing it, and the EPA standards for 1985 will be a goal which can be realized by everyone who has dust and pollution problems.

LIMITATIONS

There are limitations to the Plastic Blasting method, but in all cases, these limitations are far more desirable than the present chemical methods of paint removal with the follow-on mechanical sanding required for total removal of paint. The elimination of chemicals and the resulting effluent control will probably be the most far-reaching of the improvements gained as a result of this new process. The Plastic Blasting method is faster (generally ten times over the chemical process) cleaner, safer, and therefore produces cost effective savings over the present methods. Use on radomes which are painted with "Rain Erosion" coatings has not been successful, but at the same time, by reducing the screen size of the plastic material to 30/40 mesh, we have been able to remove paint from carbon composite surfaces, fiberglass and light weight aluminum surfaces with no damage to the substrates. The blasting action helps to stress-relieve the surfaces, does not heal cracks in aluminum and removes the paint from titanium, stainless steel, alclad and anodized aluminum alike. Alclad aluminum surfaces will have a "sand blasted" appearance after blasting because the soft aluminum clad is softer than the plastic compound. This soft aluminum coating is moved, but not removed and does present a much better surface for receiving paint. Soft cadmium coatings on screws will be removed to a certain extent and plastic windows cannot be blasted. These are the only limitations which have been identified to date.

ECONOMICS

The economics of the proposed system can be divided into several categories according to the individual order of priorities. MANPOWER is one of the major driving forces in today's

industrial world. Labor rates exceeding \$40.00 per hour are common when standard overhead costs are included. These labor savings, realized through plastic blasting, have been consistently better than a ten-to-one ratio, and these are the kinds of savings that you can realize with the first item blasted. Just imagine taking the total manpower costs of your present paint stripping operation and reducing it to one tenth of that figure the first day of your operation. TRAINING has always been a problem in the paint stripping business. As fast as people are trained, they move on to better jobs where they don't have to put up with the disgusting odors and the safety hazards associated with chemical paint strippers. The training curve for learning how to remove paint with this new process is one of the lowest in the industry. Simply point the magic wand at the painted part and pull the trigger - when the paint disappears, move on to the adjacent area...a totally sight oriented process that eliminates the requirement for people with the "Corrosion Control" skill after their names...and the pay that goes with those special skills. MATERIAL COSTS added to the manpower elevates the cost for removing paint from \$6.75 to \$9.02 per square foot on one of our military aircraft using the chemical method. The same operation can be performed for \$.70 per square foot labor plus an additional \$.25 for the plastic blasting compound. Anytime you can save 90% operating costs you have the opportunity of impressing your boss with your "fabulous intellect"...and if you are the boss, you can make your people believe that you can just about walk on water! Now, as if saving 90% of your operating costs wasn't enough, consider that you can practically eliminate your CHEMICAL POLLUTION problems at the same time. It is now time for the doubting Thomas's who are reading this, to start believing in Santa Clause and the Easter Bunny!!!!!! Those of you who are in the business of stripping paint from aircraft know that it is possible to use 400 gallons of very expensive paint stripper just to strip one aircraft. And as if that wasn't enough, you follow that by using 20 to 30 thousand gallons of wash and rinse water which becomes highly polluted and is extremely expensive to decontaminate - even to a "gray" level. The elimination of this Chemical Pollution is the bonus which could very easily become the main driving force behind changing to the Plastic Blasting Process. The Environmental Control Agency is tightening the belts of industry for

disposal of anything that is hazardous. The collection and the packaging add to the disposal costs to the point where disposal could equal the new acquisition costs of hazardous paint removing chemicals. Add to these the reduction in costs involving heat and air flow within the paint stripping facilities, and you have an "economics" package which makes this new state of the art method of paint removal a must for industry.

SUMMARY

The research and development efforts continue at most Army, Navy and Air Force overhaul facilities. After a year of testing, the Navy recommended the use of this plastic blasting process for all aircraft and ground support equipment. They are now in the process of upgrading their facilities to include a blast booth at each of the major repair depots. The Army is successfully removing paint from the interior of helicopters for the first time and they have discovered that there is a way to remove teflon coatings without damage to the substrates. The Navy is removing paint from aircraft wheels and struts without disassembly at the Alameda Air Station in California and at Long Beach, they are working with fiberglass boats. Hill Air Force Base in Utah has been the center of the basic test program for the past four years. They have been removing paint from the F-4, components removed from the aircraft with no reports of paint failures throughout the test program. Pickup trucks have been completely stripped of all paint in less than an hour. The same process can be used on glass, chrome or rubber. They now have the first operational blast facility which is large enough to remove the paint from a complete F-4 aircraft with enough room inside to do the support equipment at the same time. This facility will become the model for future construction of other Air Force, Army and Navy blast booths sized to meet individual requirements. The world is demanding a better way for paint removal without the hazards which have been associated with that process. The plastic blasting method offers us the chance to meet the demands which are being levied against us while providing the multitude of savings and advantages we have outlined here.

The plastic blast process for the removal of paint is not a panacea, but it works and the savings are real. It's just possible that it is the environmental answer to our problems throughout the world.



DEPARTMENT OF THE AIR FORCE
HEADQUARTERS OGDEN AIR LOGISTICS CENTER (AFLC)
HILL AIR FORCE BASE, UTAH 84056-5149

REPLY TO
ATTN OF MAQM (Clark/72874) 8 July 1985

SUBJECT Effects of Plastic Bead Blasting for Paint Removal on Magnesium and Aluminum Aircraft Wheels.

TO MMEAR (Mr Hansen)

1. The Metallurgical and Nondestructive Test Laboratory (MAQM) conducted a series of tests on an A-10 Nose Wheel made of 2014-T6 aluminum and a KC-135 Nose Wheel made of A2-91 magnesium to determine the effects of the bead blast paint removal method upon subsequent crack detection. The aluminum wheel contained a service-induced fatigue crack. Quench cracks were introduced into the magnesium wheel by heating and quenching it in water. These tests were conducted at the request of the NDI Program Office at San Antonio ALC and the Corrosion Program Office at Warner-Robins ALC.

2. In addition to the cracked samples, the Salt Lake National Guard brought a KC-135 main aluminum wheel to the Laboratory as an example of the difficulty the field installations might have removing paint from wheels with their available equipment.

3. From the results obtained in this study and outlined in paragraph 4, the following conclusions and recommendations appear logical:

a.- Eddy current inspection is a reliable inspection method that can be used after plastic bead blasting for paint removal on all aluminum and magnesium alloys.

b. Penetrant inspection of aluminum parts after bead blast paint removal at 30 psi or greater pressures is not a reliable inspection technique and should not be required by the overhaul/repair technical directives unless etching follows the abrasive blast and precedes the penetrant inspection.

c. Anodize stripping and chemical cleaning of aluminum alloys etch the aluminum so that cracks reopen when these processes follow paint removal by plastic bead blasting. Therefore, penetrant inspection can be performed reliably at the depot level after plastic bead blasting if and only if penetrant inspection is preceded by one of these etching processes.

d. Since many aluminum parts do not have the anodize stripped even at the depot level, penetrant inspection of these parts after plastic bead blast is not reliable and should not be required.

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e. Etching and/or removal of anodize from aluminum alloys in the field is generally not allowed, because anodize cannot be reapplied in the field. Therefore, the bead blast process of paint removal should not be required of field installations.

f. If bead blast paint removal on aluminum alloys is required of a field activity, penetrant inspection should not be required.

g. Penetrant inspection of magnesium parts after bead blast paint removal at 30 psi or greater pressures is not a reliable inspection method and should not be required by the overhaul/repair technical directives unless special etching techniques are used after blasting and before penetrant inspection. The special etching techniques referred to are not normally done at either field or depot level.

h. Emphasis is again made of the fact that eddy current inspection is a reliable inspection method even after abrasive blasting for paint removal on all aluminum and magnesium parts and should be required in place of penetrant inspection whenever etching methods do not follow the blasting operation and immediately precede the inspection.

i. All of the conclusions and recommendations given in this paragraph are consistent with the requirements of the applicable directives concerning penetrant inspection -- namely, T. O. 33B-1-1 and MIL-I-6866.

4. The results of all of the tests completed in this study are as follow:

a. Paint removal by bead blasting at 30 psi or higher pressures causes peening at the edge of crack indications in both aluminum 2014-T6 and magnesium AZ-91 alloys. This is the case whether the aluminum is bare or anodized and whether the magnesium is bare, anodized, or Dow treated.

b. The peening resulting from bead blasting severely reduces the detectability of cracks in both of these alloys.

c. Etching -- either with specific etchants intentionally used to open crack indications after blasting operations or chemical processes used in the shops to remove anodize and clean aluminum alloys -- removes the disturbed metal introduced by the blasting operation. Penetrant inspection can be used reliably for crack/defect detection after blasting on the 2014-T6 aluminum alloy only after such etching procedures follow bead blast paint removal and precede penetrant inspection.

d. The standard shop cleaning, anodize, and other chemical processes used during overhaul of magnesium alloys does not remove the disturbed magnesium metal closing the cracks in

magnesium alloys. Therefore, penetrant inspection of AZ-91 magnesium wheels is not reliable after bead blast paint removal unless a standard magnesium etchant is used after blasting and before penetrant inspection.

e. The standard bead blast procedure at Ogden ALC removes nearly all of the anodize from anodized aluminum parts.

f. The bead blast procedure available in the field (i.e. Salt Lake National Guard) does not remove all of the paint from the KC-135 main wheel without removing large areas of anodize also. In the field, limited areas of bare aluminum are allowed to be alodined. Large areas of bare aluminum require overhaul and reanodize at the depot level. It appears counterproductive to require bead blast paint removal in the field.

g. Since the field is not allowed to use chemical etchants, penetrant inspection of aluminum or magnesium parts after bead blasting can not be performed reliably in the field. However, eddy current testing can be performed because the eddy current test is subsurface and does not entirely depend upon surface contour, as does the penetrant inspection.

h. At the depot level, chemical etching of some aluminum parts (all aluminum wheels) occurs during standard stripping and cleaning procedures. Reliable penetrant inspections can be performed after bead blast paint removal if the etching, cleaning, or anodize stripping follows blasting and preceeds the inspection. Again eddy current inspection is reliable after blasting without any further chemical removal of the peened metal.

i. Following bead blast paint removal at either the depot or field levels, magnesium parts can not be penetrant inspected reliably for cracking without specific chemical etching techniques. Again eddy current inspection is a reliable inspection method after blasting without subsequent etching.

j. Additional tests with other alloys, such as the 7000 series T-6 aluminums and other AZ magnesiums, indicate results similar to those found with the 2014-T6 aluminum and the AZ-91 magnesium wheels. Since these are the highest strength aluminum and magnesium alloys commercially available, the conclusions reached in this report should be applicable to all aluminum and magnesium alloys.

5. The procedure used in this study is given in the following paragraphs. Most of the investigation centered around three parts. One A-10 aluminum wheel contained a service-induced fatigue crack in the bead seat radius. The second part was a section of KC-135 nose wheel made of AZ-91 magnesium which was quench-cracked in the laboratory. A third wheel, a KC-135 main, was brought to the laboratory by the Salt Lake Air National Guard

because the Guard was unable to remove all the paint with the bead blast system without also removing the anodize and exposing large areas of bare aluminum. In each case with the cracked samples tested in the laboratory, penetrant inspection (and photography under ultraviolet light) was performed both before simulated paint removal with the plastic bead blast and after. During the bead blasting process, one half of each crack indication was masked with heavy tape so that this half did not come into contact with the bead blast media. A photographic comparison was made of the crack detectability of the blasted crack indications and the masked areas. Photographs 1 through 7 show the A-10 aluminum wheel. Photographs 8 through 10 are the crack indications on the KC-135 magnesium wheel. Photograph 11 shows the KC-135 aluminum wheel from the Salt Lake Air National Guard. The bare aluminum where the anodize was removed and the areas where paint still adhered are shown in this photograph.

6. A summary of the procedure used with the aluminum A-10 wheel (photograph 1) follows:

a. Cleaning and visual inspection (photograph 2 under white light).

b. Penetrant inspection before plastic bead blast (photograph 3 under ultraviolet light).

c. Bead blast over one half of the crack indication for the same time as required for paint removal while the other half was masked with tape. Note the peening at the edge of the crack (photograph 4 under white light).

d. Penetrant inspection of the entire crack after the plastic bead blasting process done with 30 psi pressure. Note that the crack extends the entire distance between arrows but is only clearly visible on the half that was not bead blasted (photograph 5 under ultraviolet light).

e. The part of the crack that was not bead blasted was cross sectioned for metallographic examination. Photograph 6 (400X) is a cross section micrograph showing that the unblasted crack opens to the surface.

f. The part of the crack that was bead blasted was cross sectioned for metallographic examination. Photograph 7 (400X) is a cross section micrograph showing that the bead blasted crack has been peened closed. This is the reason that the blasted portion of the crack is not clearly detectable in photograph 5 and during penetrant inspection.

g. After the above tests were completed, the bead blasted aluminum wheel samples were sent through the normal shop production line for strip of the anodize, cleaning, and other chemical operations. The cracks peened by the plastic bead

blasting operation were etched sufficiently to open to nearly their original size and were again detectable by penetrant inspection techniques.

h. Immediately after plastic bead blasting, the aluminum wheel was inspected by the eddy current technique. The entire crack pattern, both the blasted and protected portions of the crack, were detectable.

7. The test procedure used on the KC-135 magnesium nose wheel is as follows:

a. The magnesium wheel section was heated and quenched in cold water to produce various size quench cracks. The crack pattern was inspected visually and under the microscope. The crack pattern after application of penetrant and before plastic bead blasting is shown in photograph 8 under white light and in photograph 9 under ultraviolet light.

b. On the KC-135 magnesium wheel the entire crack area was blasted with plastic beads for the same length of time required for paint removal. Subsequent penetrant inspection is shown in photograph 10 under ultraviolet illumination. Cracks before bead blasting (photograph 9) can be clearly seen; whereas, after blasting (photograph 10) only the largest cracks are visible.

c. The KC-135 wheel section was sent through the normal cleaning, stripping, and other chemical processes that magnesium parts are subjected to during overhaul. The peened cracks did not open. Penetrant inspection after the overhaul processing remained as shown in photograph 10.

d. All cracks on the magnesium wheel section were detected after bead blasting when the eddy current inspection method was used.

8. Directives governing the use of abrasive blasting media for paint removal prior to penetrant inspection are T. O. 33B-1-1, Chapter 6, paragraphs 1-36 and 3-69, and MIL-I-6866, paragraph 5.2.

Paragraph 1-36, T. O. 33B-1-1, is quoted as follows:

"1-36. SMEARED METAL. Mechanical operations, such as shot peening, machine honing, abrasive blasting, buffing, wire brushing, grinding or sanding will smear or peen the surface of metals. This mechanical working closes or reduces the surface opening of any existing discontinuities. Mechanical working (smearing or peening) also occurs during service use when parts contact or rub against each other. PENETRANT INSPECTION WILL NOT RELIABLY INDICATE DISCONTINUITIES WHEN IT IS PERFORMED AFTER A MECHANICAL OPERATION OR SERVICE USE THAT SMEARS OR PEENS THE SURFACE."

Paragraph 3-69, T. O. 33B-1-1, is quoted as follows:

"3-69. EFFECTS OF MECHANICAL WORKING. Mechanical working removes soils and contaminates by physical action. This physical action also removes or deforms the part surface. Deformation is in the form of metal flow or displacement on the part surface. The amount of deformation depends on the type and severity of the working plus the ductility of the part. Even a small amount of deformation, such as that caused by fine sanding or vapor blasting, will reduce the surface opening of small discontinuities resulting in a decrease in the effectiveness of the penetrant inspection process. Chemical etching (see paragraph 3-64) should be accomplished when penetrant inspection is performed after a less severe mechanical working process. Severe mechanical working processes, such as metal removal, shot peening, or grit blasting, can seal or close the surface openings of large discontinuities which prevents the formation of penetrant indications. Penetrant inspection SHALL be accomplished prior to mechanical working processes, such as machining, shot peening, grit blasting or coarse sanding, that severely displace surface metal. If it is not feasible to perform penetrant inspection prior to these processes, then another inspection method should be considered. An exception to this requirement is when penetrant inspection is performed to detect discontinuities formed by mechanical working, such as machining tears or grinding cracks."

Paragraph 5.2, MIL-I-6866, is quoted as follows:

"5.2 Precleaning. When inspecting by the penetrant method or methods, all surfaces of basic materials and parts shall be free from any rust, scale, welding flux, burrs, feather edges, smeared material, spatter, grease, paint, carbon, plating, engine varnish, oily film, dirt and other contaminants which could tend to mask defects or give irrelevant indications. Abrasive blasting shall be used to clean metals only if the surface of the metal is not peened by the process or if surface defects are not sealed or contaminated with the abrasive material. PAINT SHALL BE REMOVED BY CHEMICAL REMOVERS AND NOT BY ABRASIVE METHODS. All descaling solutions must be neutralized and flushed from the surfaces of the part or material as these cleaners affect fluorescence of penetrants. All parts and materials must be thoroughly dried before application of penetrant. Soft metals, previously machined, shall be etched to remove smeared metal that could mask defects. When required, steels and other high-strength, highly heat-treated metals shall be etched to remove smeared metal and baked within one hour after etching. Baking of steel shall be at 375 degrees F for three hours to remove hydrogen; for other metals it shall be the time and temperature specified for

the particular metal. After baking, parts shall be cooled to a temperature below 150 degrees F before dipping into the penetrant. When cleaning plastic materials, solvents which adversely affect these materials shall not be used."

Fred Seppi, Chief
Metallurgical Lab Branch
Quality Assurance Division
Directorate of Maintenance

cc: SA-ALC/MMEI (Mr Petru)
WR-ALC/MMEI (Mr Ivy)
OC-ALC/MMEI
MAQ
MAQN
MAQB
MMIRC (Mr King)
MMIRC (Mr Hodges)
MMIR
MMSR (Mr Elwell)
MABE (Mr Roberts)
MANE (Mr Franklin)
MANEP (Mr Carter)
MANP

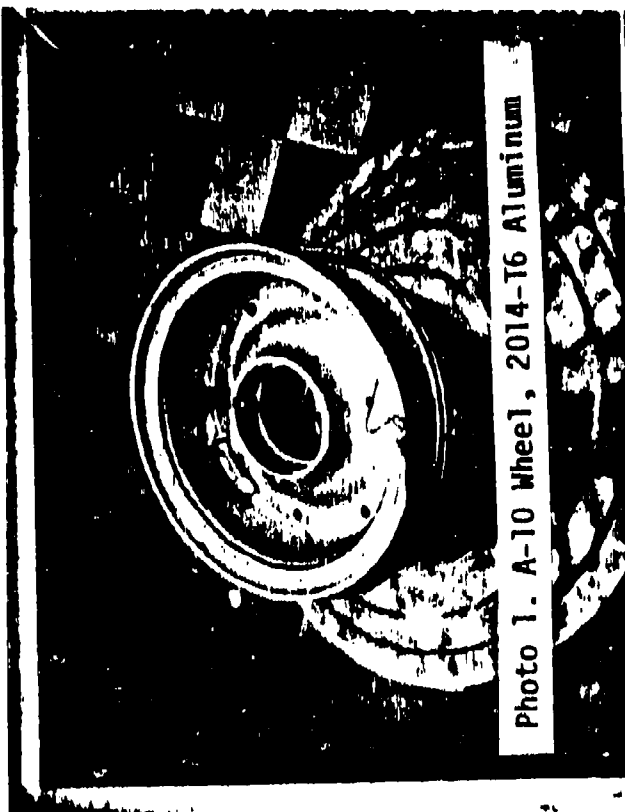


Photo 1. A-10 Wheel, 2014-T6 Aluminum

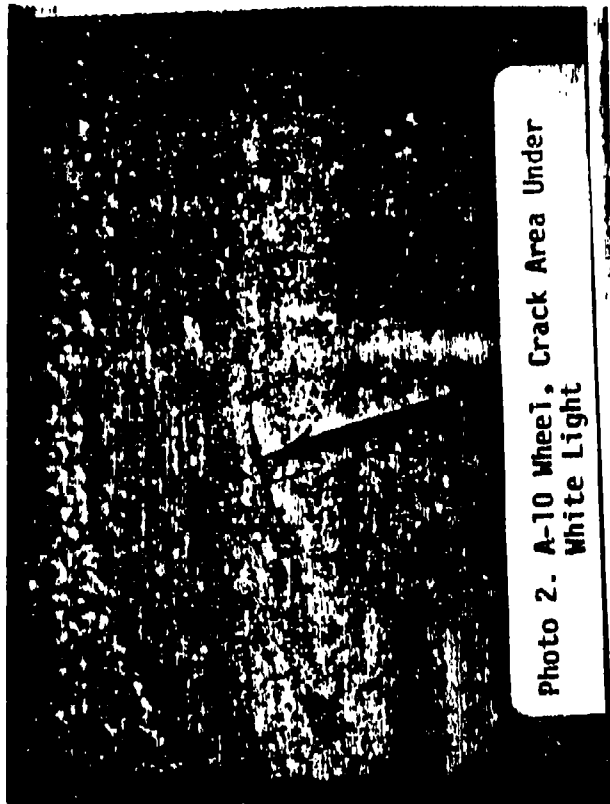


Photo 2. A-10 Wheel, Crack Area Under White Light

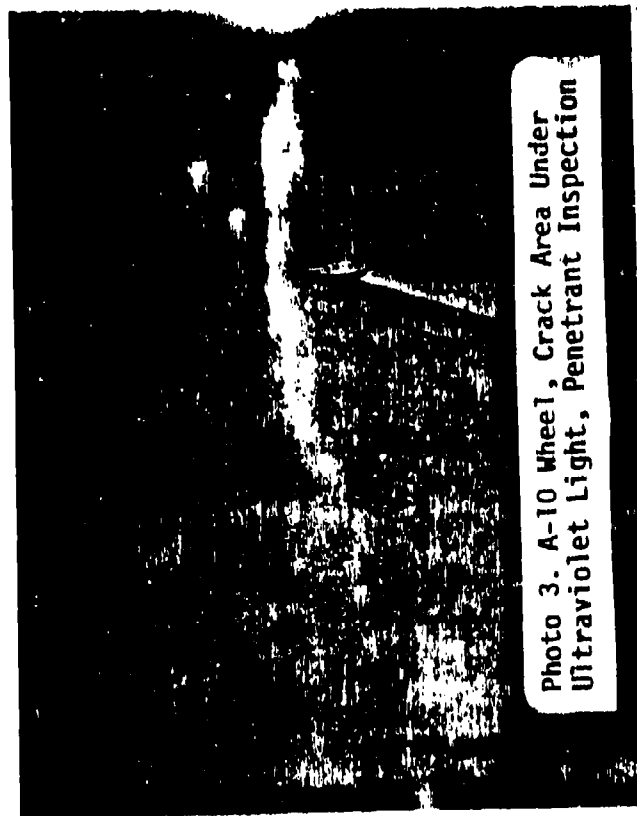


Photo 3. A-10 Wheel, Crack Area Under Ultraviolet Light, Penetrant Inspection

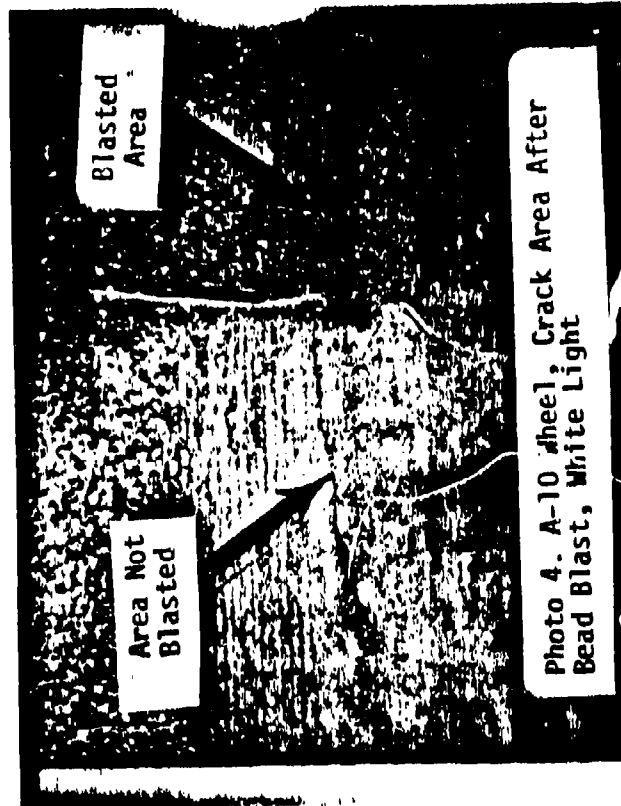


Photo 4. A-10 Wheel, Crack Area After Bead Blast, White Light

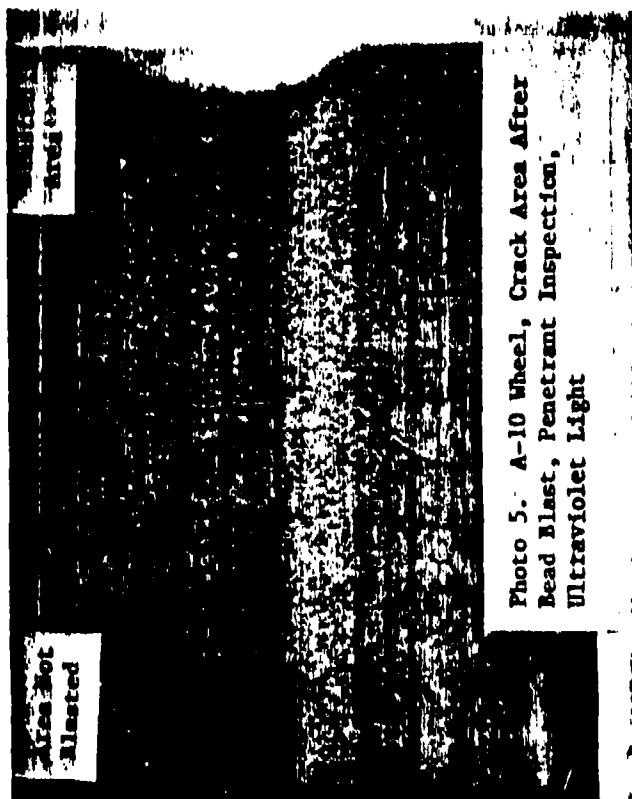


Photo 5. A-10 Wheel, Crack Area After Bead Blast, Penetrant Inspection, Ultraviolet Light

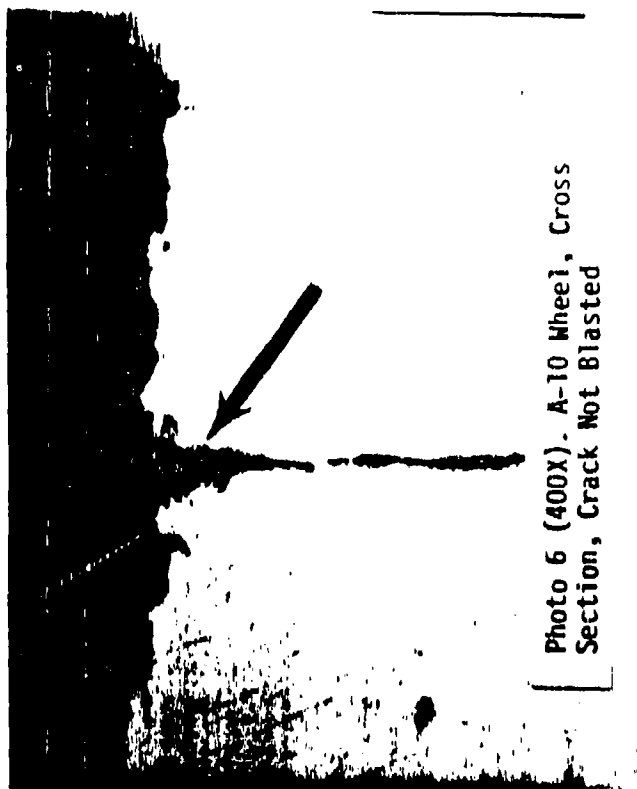


Photo 6 (400X). A-10 Wheel, Cross Section, Crack Not Blasted

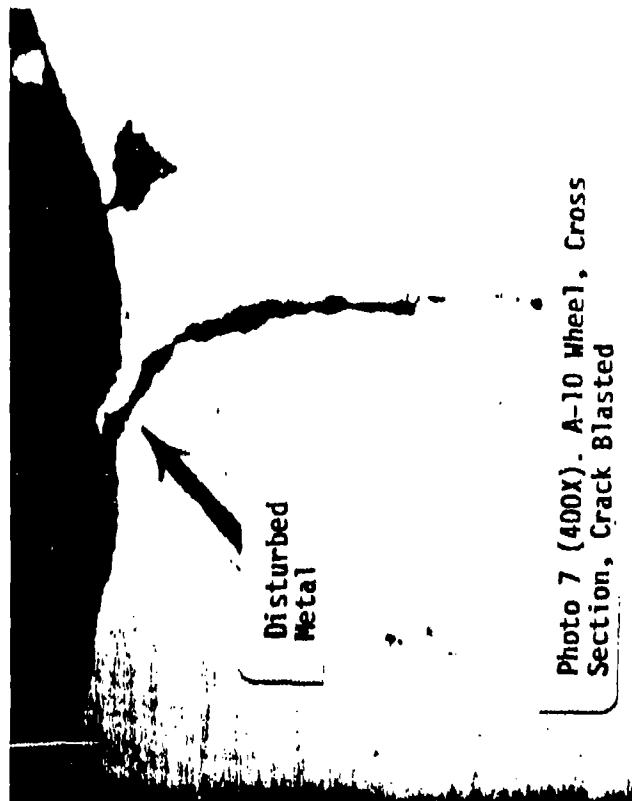


Photo 7 (400X). A-10 Wheel, Cross Section, Crack Blasted

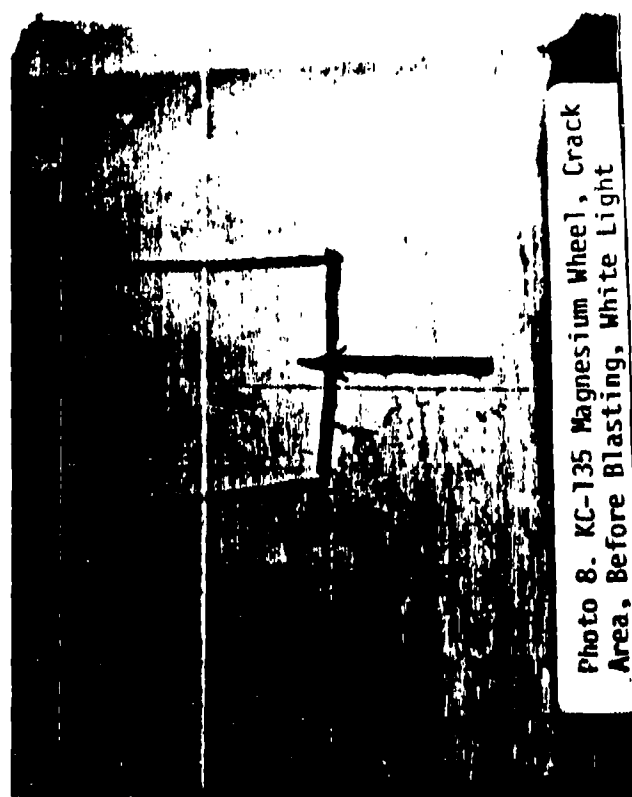


Photo 8. KC-135 Magnesium Wheel, Crack Area, Before Blasting, White Light

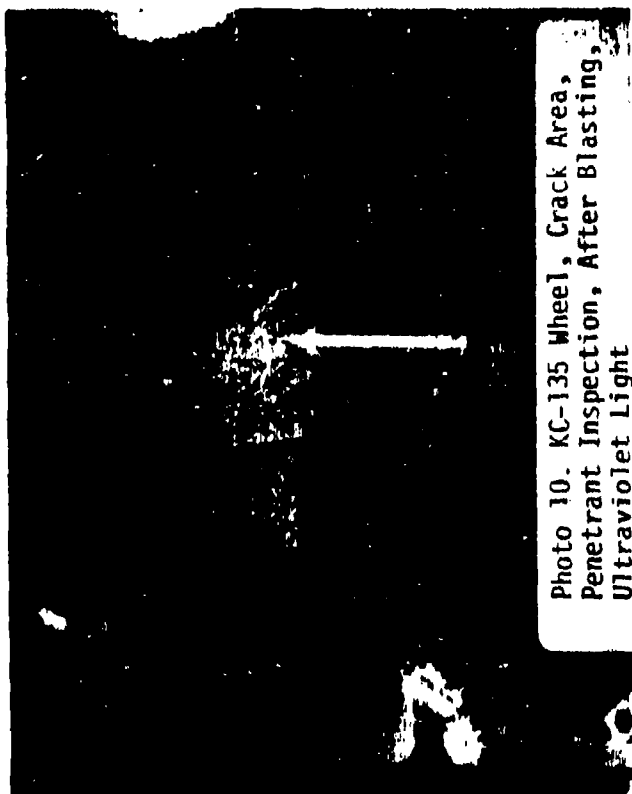


Photo 10. KC-135 Wheel, Crack Area,
Penetrant Inspection, After Blasting,
Ultraviolet Light

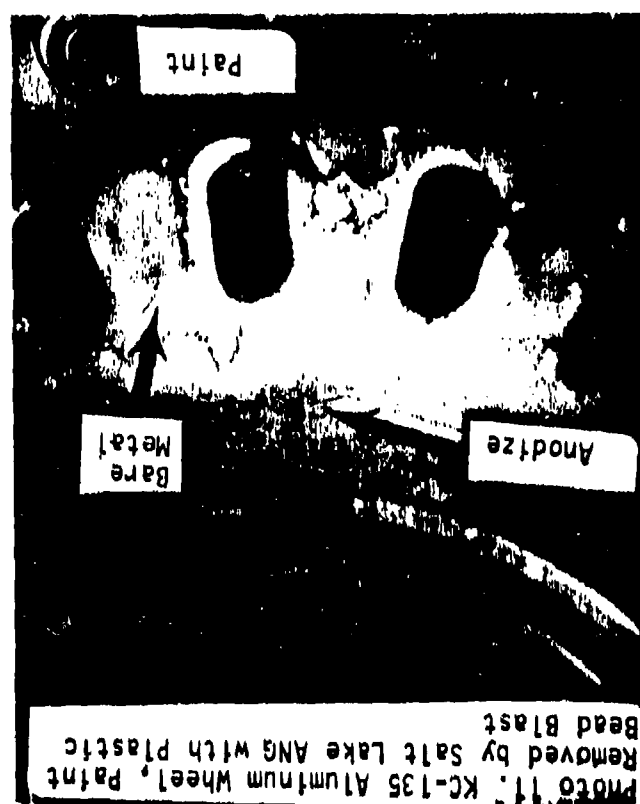


Photo 11. KC-135 Aluminum Wheel, Paint
Removed by Salt Lake ANG with Plastic
Bead Blast

APPENDIX 2.3

PLASTIC BEAD BLAST PAINT REMOVAL BOOTH
HILL AIR FORCE BASE, UTAH
Project No. W18680.A0.02
CH2M HILL, April 1985

ENGINEERING APPRAISAL

INTRODUCTION

A site visit was made on April 1, 1985 by R. Hanson of CH2M HILL at which time the blasting booth facility was examined. Using his military experience of aircraft maintenance and repair, Mr. Hanson produced the following report.

OBSERVATIONS

The major items of equipment have been installed and are ready to operate. Some minor air ducting and piping still remains to be fitted. The internal wall covering and the suspended ceiling have yet to be installed and the live floor pipe connections to be finished.

The live floor appears to have been very well designed and fabricated. The structural strength of the floor has been built into its integral ducting system and has been fabricated in standard sized module sections to facilitate ease of removal if damaged. The floor dust collection troughs are steeply sloped to provide good material flow and are protected from loads by the floors supporting members. These troughs are covered by fine wire mesh screens to catch oversized debris or discarded "trash" and prevent plugging of the "draw down" holes at the bottom of these troughs. The entire live floor trough system is covered by standard grating in panels sized for easy manual removal.

The live floor system covers the entire floor area of the blast booth, wall to wall. The floors air duct system is designed to provide equal suction force over the entire floor area. This will enable simultaneous blasting areas to be used throughout the booth, under normal blasting pressures, without any loss of suction force in any particular area. This system will prevent any "dead" areas, a feature not found in other live floor air systems.

The floor was installed in a custom built concrete floor but could easily have been installed on top of an existing concrete hanger floor. The live floor structure is only 6 inches deep. If mounted on an existing floor would only require shallow ramps to be poured from existing grade to the top of the floors grating.

APPENDIX 2.3

PLASTIC BEAD BLAST PAINT REMOVAL BOOTH
HILL AIR FORCE BASE, UTAH
Project No. W18680.A0.02
CH2M HILL, April 1985

ENGINEERING APPRAISAL

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OBSERVATIONS

The major items of equipment have been installed and are ready to operate. Some minor air ducting and piping still remains to be fitted. The internal wall covering and the suspended ceiling have yet to be installed and the live floor pipe connections to be finished.

The live floor appears to have been very well designed and fabricated. The structural strength of the floor has been built into its integral ducting system and has been fabricated in standard sized module sections to facilitate ease of removal if damaged. The floor dust collection troughs are steeply sloped to provide good material flow and are protected from loads by the floors supporting members. These troughs are covered by fine wire mesh screens to catch oversized debris or discarded "trash" and prevent plugging of the "draw down" holes at the bottom of these troughs. The entire live floor trough system is covered by standard grating in panels sized for easy manual removal.

The live floor system covers the entire floor area of the blast booth, wall to wall. The floors air duct system is designed to provide equal suction force over the entire floor area. This will enable simultaneous blasting areas to be used throughout the booth, under normal blasting pressures, without any loss of suction force in any particular area. This system will prevent any "dead" areas, a feature not found in other live floor air systems.

The floor was installed in a custom built concrete floor but could easily have been installed on top of an existing concrete hanger floor. The live floor structure is only 6 inches deep. If mounted on an existing floor would only require shallow ramps to be poured from existing grade to the top of the floors grating.

The live floor plenums are connected by ducting in the equipment room to the vacuum equipment and the dust collection and separation systems. The dust separation and collection equipment is located outside the building and consists of screening equipment mounted on top of a dust collector. The reclaimed plastic beads are returned to the bead storage hoppers via steeply inclined chutes thru the wall of the building. The collected dust is discharged from the bottom of the dust collector hopper into sealed drums outside the building.

The plastic bead storage hoppers are located inside the equipment room and are mounted above the blasting system machines. The blasting system consists of five Paulli and Griffin 10 cubic feet vessels each with its own set of controls and gauges which can be preset and locked. These vessels are each connected to header pipes running along the north and south walls of the blast booth. There are five separate and independent blasting hoses each having a half-inch nozzle strategically placed to cover the entire blasting area.

A single 100 hp air compressor supplies the blast air to all five blasting machines and enables a blasting pressure of 40 P.S.I max to be maintained at each of the five nozzles. Make-up air is filtered and dried. The weight of each of the blasting hoses will be carried by overhead counter weighted mechanisms to reduce operator fatigue and to keep the hoses from dragging on the deck and clear of the equipment being blasted.

Specially designed, wheeled work platforms have been built to provide access to all surfaces of an aircraft or other equipment being treated. The wheels are sized to operate over the floor grating and include locking mechanisms. These platforms include floor grating of industrial grade and all the proper handrails. Where the work platform frame may come in contact with aircraft surfaces, the structure has been covered with thick rubber cushions to prevent damage to these surfaces.

The building which encloses the blasting booth is spacious and provides an adequate working area with room to spare. The building is divided into two separate areas both totally enclosed and insulated. One area is the blast booth itself, the other smaller areas is the equipment room. The blast booth has four doors. The main access door, which spans the entire width of the booth is located on the west end. The door is a standard horizontal hinged split overhead hanger type door. The south side of the booth has a standard overhead roll type door for equipment access and a standard personnel access door. Adjacent to it, is a similar personnel

access door on the north side of the booth. Each of these doors are connected to a warning device consisting of a red strobe light mounted at the ceiling which will be activated in the event that someone enters the booth during blasting. The opening of any one of these doors will also automatically shut down the blast air supply to the nozzles.

Fire protection in the blast booth is provided by a halogen gas suppression system mounted at the ceiling. This system is used because the blasting and reclaim system is an absolute dry system which prevents the use of a water sprinkler type fire suppression system.

Lighting in the booth is supplied by twelve lights, recessed into the booth walls, as well as overhead lighting which should eliminate most shadows.

The blast booth includes a suspended ceiling and finished internal walls to reduce buildup of dust to a minimum. Due to the downdraft nature of the recovery system, (live floor and overhead return air) very little dust should be in suspension in the air. Because the dust is of an inorganic material, air flow and dust level monitors should not be required in this facility, and have not been included. Should OSHA rule that they are required they can easily be added at a later date.

The equipment room takes up about one-fifth of the building and is located at the east end. It is completely isolated from the blasting area and does not include access doors between itself and the blasting area. This has been done to prevent ingress of dust into the equipment room and the inadvertent access into the blast area by untrained personnel who may be working in the equipment room. A control/observation room has been built into the wall dividing the blasting area and the equipment room with the access door inside the equipment room. This room should provide good observation of the blasting procedure for visitors, and later provide an excellent supervisors booth allowing supervision of the blasting without having to enter the blasting area.

GENERAL COMMENTS

The facility as it exists at Hill Air Force Base has been well designed. Its development and installation have progressed concurrently with an ongoing program of research and development. Testing on a smaller scale established the parameters of an efficient, clean system leaving only the sizing and selection of equipment to achieve the correct process.

Compared to the conventional methods of paint stripping by the use of solvents, especially for aircraft, this system can only be described as clean and non polluting. Having been involved with aircraft maintenance in the Air Force, this observer greatly appreciated the simplicity and efficiency of the radically new system. This system requires very little skill at all to operate the blast nozzles to remove paint from any surface, and even if the operator was lacking in normal coordinated hand/eye skills it would be virtually impossible to damage the metal surface under the paint. I personally used the system to remove some of the toughest paint from an aircraft panel and deliberately attempted to damage the aluminum surface by over-blasting. I found it to be impossible once the paint was removed to damage the surface in any way. In the hands of a completely unskilled, untrained operator the only result possible with this equipment is the complete removal of all paint and other coverings from the metal surface. This after all, is the purpose of the whole process.

When dealing with the removal of paint from "fiberglass" surfaces, the degree of skill required is a little higher. If the blasting media is directed onto the "fiberglass" surface for too long a period after the paint is removed, some damage can result. This is easily seen however, even to an untrained eye, that the process can be discontinued before real damage occurs.

RECOMMENDATIONS

In order to reproduce the blasting booth facility at other locations, it will be necessary to put together a complete engineering package consisting of engineering drawings for all disciplines, engineering and equipment specifications, installation and operating instructions.

It is recommended that the system be engineered as a fully complete and independent module that can be used in any combination to suit production requirements or site conditions without the need for additional engineering. This way, one module or combination of modules will suit all requirements and the integrity of the blasting process will be maintained. The blasting booth at Hill Air Force Base can be the model for the single booth module. This module is sized for one fighter type aircraft and it's disassembled parts, two modules back to back sharing the same equipment room, would service two aircraft simultaneously (see Figure 1). Two of these tandem units side by side would service four aircraft simultaneously with the equipment room still central to the whole facility (see Figure 2).

In order to service a larger aircraft, i.e. a multi-engined air tanker or similar sized aircraft, four or more single modules could be used with the live floor sections adjacent to one another, and the equipment rooms located on the sides of the building (see Figure 3.)

By establishing a standard engineering package, standard costs can be set within an acceptable range which need not be exceeded no matter where the facility is built. Cost control therefore remains with the purchaser and prevents the usual "add-ons" of equipment and processes. "Add-ons" that would not significantly improve the blasting process. For the military, this would provide insurance that they would get the exact system they needed without deviation, over-runs, and delays.

Some features of the blasting booth system are exclusive to Royce Mechanical Systems of Ogden, Utah and are proprietary. These however need only be treated as pieces of equipment which can be specified as such "or equal". It then becomes the responsibility of the general contractor to supply this equipment or its "equal" without infringing upon any patents.

The engineered module should include provisions for installation, of the system in existing buildings, as well as installation on "raw" sites. The system lends itself easily to both conditions with only minor considerations. The structural requirements of the building itself are only for a cover or shell and does not require the support of any of the equipment. Therefore, local requirements can be easily met without effecting the blasting process.

A study will have to be made to determine standard aircraft hanger sizes, both military and civilian before the module size can be established. An alternative would be to size the basic module, based on a range of aircraft sizes i.e. a military fighter aircraft as the smallest, up to a Boeing 747 as the largest. Anything larger would require special considerations but would still utilize the standard multiple module concept.

Blast booths for other equipment such as vehicles, tanks, small boats, etc., would pose no problems as these all fit well with the single or tandem module facility.

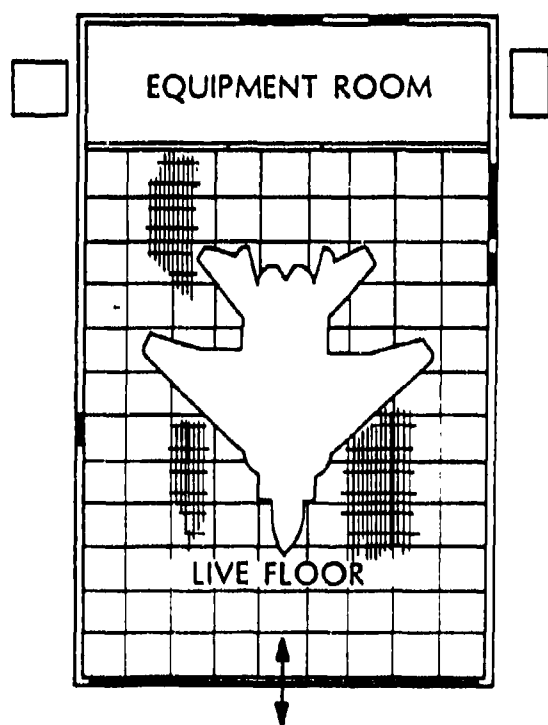
CONCLUSIONS

This blasting booth paint removal concept is so simple and efficient that it lends itself perfectly to a wide variety of uses both military and civilian. Its most notable feature however, is the fact that it almost entirely eliminates pollution and toxic waste. The only waste product of this

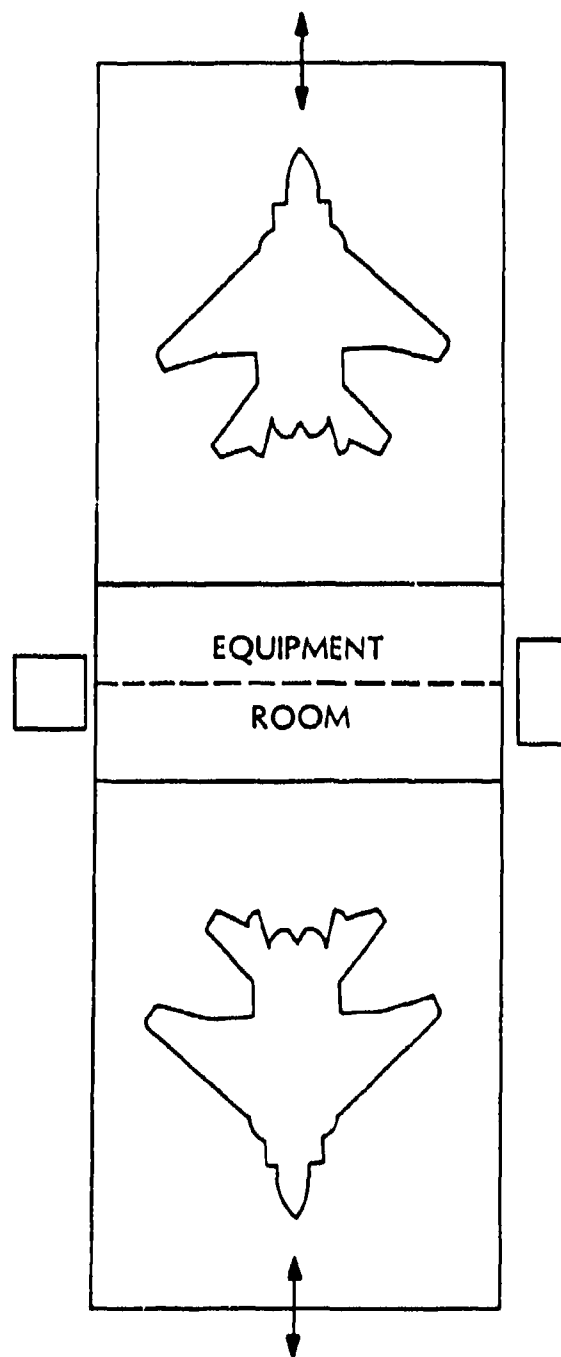
system is a comparatively small amount of dry fine plastic dust and paint particles containing 12.2 PPM chrome, a small trace of lead, and a small trace of cadmium. This waste is easily contained within plastic lined drums, which when sealed, can be easily transported for disposal or storage. The possibility exists that this material can be injected into a commercial furnace, as a fuel additive because of its high BTU content, thus solving the disposal problem. There is no liquid waste generated by this blasting system, and because the air system is self contained and recycling there is no air pollution.

The plastic bead blasting media is recycled and used with very little loss by degradation and the only negative aspects of this material is that it is a single source product.

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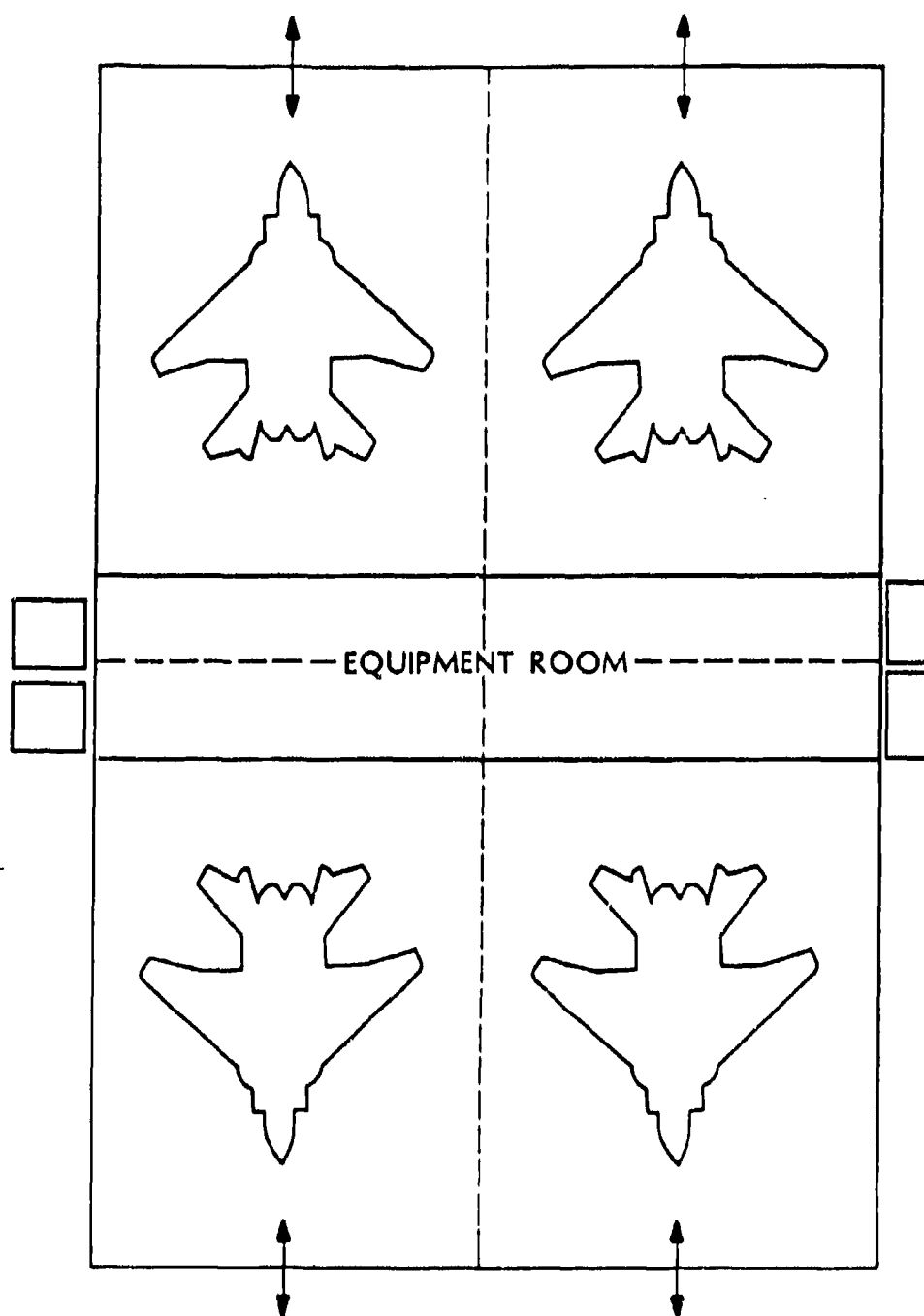


SINGLE MODULE
SINGLE BOOTH



TWO UNIT BOOTH
(TANDEM MODULE)

FIG 1
1C-20



FOUR UNIT BOOTH
(DOUBLE TANDEM MODULES)

FIG 2
10-21

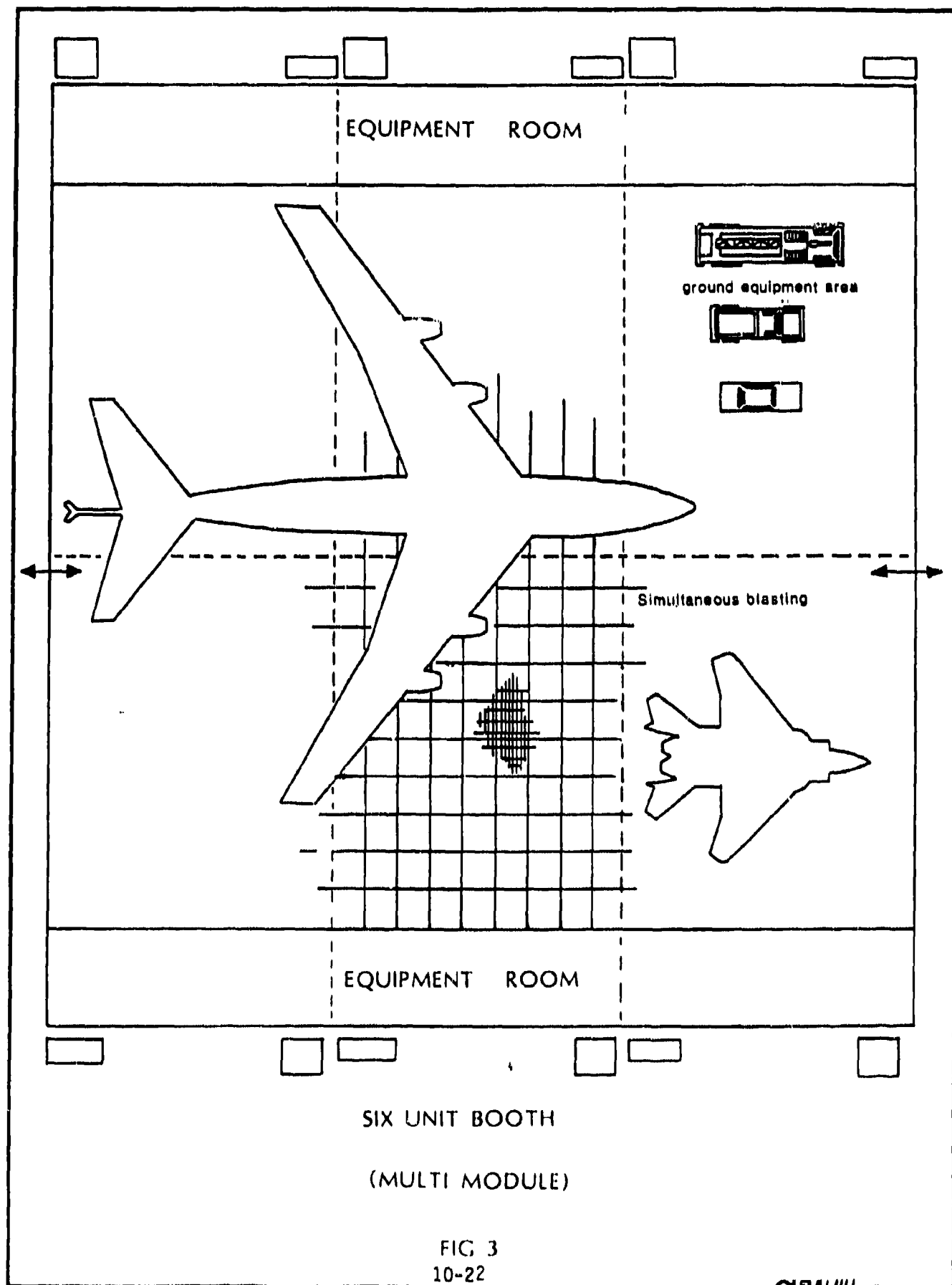


FIG 3
10-22

CHM HILL

ABRASIVE BLAST CLEANING, A VIABLE ALTERNATE
TO CHEMICAL STRIPPING OPERATIONS

by

JOE GARDNER

Director, Government Sales
CLEMCO INDUSTRIES

ABSTRACT

Low pressure abrasive blast cleaning, utilizing plastic abrasives, has proven to be a viable alternative to chemical stripping operations for paint removal on aircraft and ground support equipment.

The following article notes the benefits of this new process, and focuses on the equipment selection requirements.

CHEMICAL STRIPPING HAS BEEN the accepted method of surface preparation on materials such as titanium, stainless steel, aluminum, fiberglass, Kevlar and other composites until recently.

In the last eighteen (18) months extensive research and development activities have been undertaken by various Defense Department agencies, commercial aircraft manufacturers, rapid transit districts and others, on the process of blast cleaning with plastic abrasives at low pressures.

The results have been dramatic and consistent. This new method allows paint removal on even soft surfaces such as aluminum or fiberglass at a fraction of the time and expense of current chemical stripping operations. Low pressure blasting with plastic abrasive has been employed on several complete aircraft and numerous subcomponent parts, allowing a vast decrease in maintenance

and down time. An additional benefit is the elimination of the disposal problems of thousands of gallons of hazardous contaminated water associated with the chemical stripping process.

This new process is similar to sandblasting where particles of sand are propelled by compressed air through a nozzle. There are vast differences, however, in the abrasive media, equipment, blasting pressures and operator techniques employed.

In operation, a special pressure vessel, commonly referred to as a blast machine or "pot," is filled with plastic abrasive. Compressed air is employed to activate the blast machine, creating a balanced pressure condition, which allows abrasive to be gravity fed through the conical bottom of the blast machine and through an abrasive metering valve. Compressed air propels metered abrasive through static dissipating hose and a venturi shaped nozzle, accelerating the particles at speeds up to 660 feet per second. Abrasive particles strike the work piece and the force of this impact breaks down and removes the layer(s) of paint resulting in a cleaned surface.

VARIABLES AS TO THE TYPE OF SURFACE FINISH ACHIEVED AND THE PRODUCTION RATE ARE:

- Blasting pressure at the nozzle, normally ranging from 35 PSI to 50 PSI for aircraft applications.
- Distance of the nozzle from the workpiece and the angle at which it is held.
- Abrasive type and mesh (particle size).
- Composition of, and coating on, the workpiece.

We will elaborate on some of these points, but will concentrate primarily on the subject of equipment design and selection.

THE ABRASIVE MEDIA

The abrasive used in this method is a polymerized thermoset plastic composed of a

Gardner

#1

copolymer of unsaturated polyester and styrene. Specific gravity ranges from approximately 1.15 to 1.50, with a hardness range of 3.0 to 4.0 on the MOH scale. Typical bulk density ranges from 45 to 60 pounds per cubic foot. This abrasive media is available in graded Standard U.S. Sieve Sizes ranging from 12 to 80 mesh.

EQUIPMENT

Clemco manufactures a wide range of equipment to fit almost any conceivable application. It is critical to note, however, that conventional sandblasting equipment is not suitable for this process, and certain modifications are required.

BLAST MACHINES

Blast Machines are ASME coded pressure vessels available in a variety of sizes. Six cubic feet is the most common capacity. A 60 degree conical bottom is critical to insure the correct angle of repose for uninterrupted abrasive flow. A pressure regulator with gauge will be required to tailor precise air pressure requirements.

DESIRABLE BLAST MACHINE DESIGN FEATURES INCLUDE:

Unrestrictive Formed Piping to guarantee air flow without pressure loss caused by elbows and sharp bends.

Self Cleaning Exhaust Muffler to reduce bleed off noise to an acceptable level.

Pneumatically Operated Remote Controls incorporating an abrasive cutoff switch. This configuration provides not only the OSHA required Deadman on/off controls, but also allows the blast operator the flexibility of turning off the abrasive supply only, and then using the compressed air for blow down and clean up purposes.

Moisture Separator for moisture condensation due to the hydro-agglomerating nature of plastic abrasives.

Lightweight Flexible Blast Hose, Nylon Couplings and a Urethane Jacketed Silicon Carbide Nozzle are employed because of the degree of operator precision and control required.

OPERATOR SAFETY EQUIPMENT

Operator safety equipment should consist of a Class A OSHA/NIOSH approved protective helmet with a wide span viewing lense, a helmet air filter, and carbon monoxide (CO) monitor/alarm (where applicable). A climate control tube allowing the operator choice of air conditioned or heated air is highly recommended to reduce fatigue. A leather faced cotton backed blast suit and leather gloves complete the blast operator safety package.

PRESSURE BLAST CABINETS

Pressure blast cabinets, commonly referred to as "Glove Boxes", are ideal for surface preparation of aircraft subcomponents. It is important to differentiate between suction blast designs, (which only achieve 20% of the cleaning rate and are less suitable to this application) and pressure blast cabinets. The latter are high production units which incorporate a small blast machine (again, a 60 degree conical bottom and a pressure regulator are required).

DESIRABLE PRESSURE BLAST CABINET FEATURES ARE:

Cyclone Reclaimer, incorporating a removable debris screen, to process and filter the abrasive prior to reuse.

Dust Collector allowing continuous cleaning of exhausted air by the use of tubular cloth filters mounted in a steel enclosure.

COMPLETE ABRASIVE BLASTING AND RECOVERY SYSTEM

Complete abrasive blasting and recovery systems are available for under \$16,000 and are highly recommended for introduction of this process to an aircraft maintenance organization.

A typical system (available in either skid mounted or yard towable versions) should incorporate the following components:

Complete Blast Machine Package including operator safety equipment.

Abrasive Recovery System Design allowing vacuum pick-up of spent abrasives from the floor area via a choice of lightweight hand held pick-up tools. A high pick-up rate of up to seven (7) tons per hour is highly recommended to minimize disruptions and down time of the blasting operation.

Abrasive recovery systems are available in either pneumatically driven adjustable classifiers or mechanical multi-deck vibratory screening systems. The pneumatically driven adjustable classifier offers the tremendous advantage of speed in separating dust and fines from reusable abrasives. This design should be used in accordance with a simple vibrating trash screen for removal of debris and large paint chips.

Multi-deck mechanically driven grysoscopic vibrating screen systems are also available as an alternative method of separation of debris and fines for reusable abrasive. These systems form a bottleneck to the entire process however, due to their slow screening rate.

The clean recovered abrasive is returned to the blast machine either mechanically or pneumatically. Again, the speed of abrasive transfer should be a primary consideration. An additional advantage of the pneumatic design is the ability to rapidly load abrasive

from their original containers to the blast machine. Conversely, this design also allows for a quick return of classified/screened abrasive into the original containers at the end of blasting operations.

A Dust Collector should be included in the system for containment of all dust and fines separated from the spent abrasive. Dust Collectors are available in a variety of designs ranging from a simple cloth filter system, manually cleaned, to sophisticated automatic systems. A reverse pulse jet design, automatically self-cleaning, provides for continuous operation without any disruption to operator blast cleaning activities. This design allows for dust particles to collect on the outside of cartridge filters, with only clean air being exhausted into the atmosphere. Timed air pulses automatically keep the cartridges clean and at peak efficiency.

IN SUMMARY, a complete abrasive blasting and recovery system should allow for:

Uninterrupted Abrasive Blasting Activities At Variable Air Pressures.

Complete Operator Accessories and Safety Equipment, featuring lightweight hose, couplings, nozzle, abrasive cut-off switch for ease of operation, wide span air conditioned/heated air-fed helmet, leather faced blast suit and gloves for comfort and increased productivity.

High Volume Vacuum Pick-up of Spent Abrasive From The Floor Area.

Rapid Abrasive Classification and Screening.

Pneumatic Loading Of New Abrasive From Their Original Containers and return of spent abrasive.

Reverse Pulse Jet Dust Collector, automatically self cleaning, for continuous operation.

MODIFICATION OF EXISTING FACILITY

Modifying an existing facility is a cost effective method of achieving a complete paint stripping operation. The basic components are:

An Existing Weatherproof Hanger or similar enclosure can be easily converted into a blast room, by the addition of a dust tight door, baffled/screened air inlets, an exhaust outlet, and dust tight fluorescent light modules. These modifications are primarily to allow for ventilation of the enclosure for dust control purposes.

The enclosures should be sized to allow a minimum of (4) four feet around the largest work piece, but should not be significantly larger as the enclosure size affects the dust collection requirements.

A Complete Abrasive Blasting And Recovery System Should Be Added Per The Previously Noted Design Recommendations. The only additions would be a recessed hopper with sides sloped at 60 degrees and the bottom feeding a pick-up tool. The top of this

hopper would be covered by a grating which would be flush with floor level. For recovery purposes the spent abrasive would be "blown" toward this recessed hopper via use of the abrasive cut-off switch at the blast nozzle. Plastic abrasives are moved quite readily over a concrete floor by compressed air and the clean up of even large areas is easily accomplished. Once in the hopper the abrasive is gravity fed to a pick-up nozzle, processed through the recovery/reclaimer system and returned to the blast machine for reuse.

A Room Dust Collection System should be added to allow for operation visibility and containment of dust emissions. In most cases this will be an independent component and not tied into the recovery system.

Dust Collector sizing is directly related to the interior dimensions of the blast enclosure. For rough calculation purposes the cross sectional area ($W \times H = \text{sq. ft.}$) is multiplied by a 50 FPM ventilation rate to arrive at the total air volume required. As an example, a 40' long x 30' wide x 20' high enclosure would require 30,000 CFM of ventilation ($30 \times 20 = 600 \text{ sq. ft.} \times 50 \text{ FPM} = 30,000 \text{ CFM}$). The major exception would be for rooms over 50 feet in length where a minimum of one air change per minute should be achieved (i.e., 85' length x 30' width x 20' height volume = $600 \text{ sq. ft.} \times 85 \text{ FPM} = 51,000 \text{ CFM}$).

There are various types and designs of dust collection systems available, the most common system being the "baghouse" with a series of tubular fabric filters that collect dust on the interior surfaces. These units must be shut down during their mechanical bag cleaning cycle and thus are classified as "Intermittent Dust Collectors".

The second major design is the previously mentioned reverse pulse-jet dust collector which is capable of continuous operation and higher air to cloth ratios. It is also a more compact design.

From an equipment selection standpoint, the baghouse design should not be discounted. Although not state of the art in design, this system has proven to be reliable and is far less costly than a reverse pulse jet dust collector.

COMPLETE BLAST FACILITIES

Complete blast facilities are available incorporating all the features noted in the "modification" approach. Full area recovery systems are available consisting of a series of recessed hoppers that pneumatically convey abrasive through interconnecting ducts to a classification and screening system, and then redeposit the cleaned abrasive in the blast machine(s) for reuse.

Associated components such as monorails, workcarts, electrical control panels and similar items can easily be incorporated into the total facility design.

AIR COMPRESSOR

An air compressor is the final component required for any paint stripping facility. A rotary type compressor is preferable due to its capability of consistently providing a high volume of compressed air. They also provide a reduction of moisture problems created by older piston type designs.

AIR DRYER/AFTER COOLER

Excessive moisture presents a problem when blasting with plastic abrasives. Even in non-humid climates, the natural cooling of compressed air from the compressor will result in condensation in the system. If moisture adversely affects system performance, it is recommended that an aftercooler be used in conjunction with coalescing filters. Under extreme conditions of heat, humidity and a poorly maintained compressor, the addition of an air dryer may be necessary.

APPENDIX

3.0 Manufacturers' Literature

- 3.1 U.S. Technology Corporation
Blast Cleaning Media
- 3.2 Clemco
Abrasive Blast and Recovery System
- 3.3 Pauli & Griffin
Closed Cycle Spot De-Painting Machines
Plastic Reclaimable Abrasive Machines
- 3.4 Schmidt
Plastic Blast Media System - Blast N' Vac



TECHNOLOGY CORPORATION

A Subsidiary of U.S. Plastic and Chemical Corporation

June 14, 1985

Brian Higgins
PEER CONSULTANTS
Suite 202
1160 Rockville Pike
Rockville, MD 20852

Dear Brian:

It was great speaking with you the other day. I thank you for your courtesy in returning my phone call so promptly. Hopefully it didn't interrupt your vacation time.

As we agreed during our conversation, I have enclosed 20 sets of information that describe our products and some of the applications for which the media can be employed, particularly in reference to aircraft surface accumulation removal.

Drew Descher was kind enough to forward copies of the Phase I Report and the Purdue University Paper. Both are excellent presentations which I took time to carefully review.

Some comments: on page 3-2, paragraph 2, reference is made to the fact that epoxy and urethane paints must be chemically presoftered prior to dry blasting. This statement is no longer appropriate due to the fact that modifications have been effected in both media selection and delivery systems that permit these types of paints to be removed without requiring the use of chemicals as a softening agent. Some early evaluatory testing had been conducted by both the U.S. Air Force and West German Air Force along these lines, but, to the best of my knowledge it was discontinued as advancements in application procedures eliminated this requirement. Recent test data indicates that with the proper incorporation of media type, media size, air pressure, and angle of attack even dead soft alclad aluminum can be blasted successfully. The resultant finish will have a slightly roughened, sanded feel, which in effect provides a superb anchor pattern for later paint adhesion.

Also on page 3-2, paragraph 4, mention is made that the media is not amenable for treating thin-skinned composite structures. Recent

developments in fact, present just the opposite case. Findings at both Pensacola NARF and Corpus Christi Army Depot show the media to be an exemplary material for use in removing paint from extremely thin fiber-composite helicopter fuselage assemblies. Corpus Christi just recently presented a report in which the facility strongly advocates the use of this system on virtually all helicopter components and assemblies from which paint has to be removed during regular maintenance intervals. For further information I suggest you contact John Bullington (512) 939-3555 or Randy Williams (512) 939-3243 about their findings and recommendations in this regard.

I hope that this information will be of assistance to you in your report preparation. Should you need any further information please do not hesitate to contact me.

Sincerely,

U. S. TECHNOLOGY CORPORATION

Vesa M. Rajaniemi
Vesa M. Rajaniemi,
Manager

VMR/rmb

enclosure

Important additional comment:

Please take note that U.S. Blast Cleaning Media is available for Government procurement under the following contract:

General Services Administration
New Item Introductory Schedule (NIIS)
GS-OOF-79342

(contract copies are enclosed within each literature package)



AIRCRAFT PAINT REMOVAL

US Media is an important addition to the aircraft maintenance industry. The material has proven itself to be extremely effective for the removal of paint, carbon, sealant, grease, oil, and dirt deposits from aircraft components without causing harm to the substrate.

Periodically, surface coatings and other buildup must be removed from aircraft during their normally scheduled repair and refurbishment cycles. Currently, the technique used to remove these coatings is based on the application of toxic chemical strippers. This method is expensive, time consuming, and dangerous to both man and the environment.

Because of the adverse conditions associated with chemical paint stripping, an alternate method is needed to meet ever increasing EPA regulations. This method now exists.

US Media is capable of removing surface buildup from areas which, up until now, necessitated the use of harsh chemicals. Because of the media's sharp edged surface characteristics and specific hardness range, the material is a superior paint remover when used with the appropriate blast cleaning equipment.

For example, the media can be used to remove:

- protective coatings such as polyurethane, acrylics, lacquers, and structural adhesive off exterior surfaces
- dirt and other buildup off landing gear components
- polysulphide sealants from fuel tanks
- surface accumulation off virtually any exposed area

The cleaning action of the media provides control for the removal of surface accumulation that never before was possible with the use of toxic chemicals or damaging mechanical scraping and sanding operations. For instance, the distance between the workpiece and the blast nozzle can be varied to provide the capability of removing one single layer of paint, or several, all at once, down to the base substrate without marring or damaging the surface.

IMPORTANTLY — US Media can be totally discriminatory in the number of layers of paint that are to be removed. Chemical stripping invariably removes either more or less than is actually required. Chemical stripping also necessitates the follow-up use of mechanical scraping and sanding to take off whatever the chemical solvents were not able to remove. This scraping and sanding always entails the loss of substrate material. This loss can be eliminated by the use of US Media.

The use of chemical strippers poses significant problems. Their use releases dangerous fumes into the work area, creates dangerous work conditions for personnel, and results in waste products which are difficult and extremely costly to dispose of. US Media provides an immediate, off-the-shelf solution to the ever increasing problems and hazards inherent in the use of the chemical strippers.



326 KENNEDY DRIVE, PUTNAM, CT 06260 / (203) 826-2767 / (800) 243-1842 / TELEX 82-9488



BLAST CLEANING MEDIA

INFORMATION HANDOUT

MATERIAL:

U.S. Blast Cleaning Media. Available in three formulations:

POLYEXTRA
POLYPLUS
TYPE III

Manufactured by:

U.S. Technology Corporation
328 Kennedy Drive
Putnam, CT 06260
(203) 928-2707

GENERAL DESCRIPTION:

- a. Basic Use - material is a non-abrasive plastic blast cleaning media used to remove surface residue, buildup, and contamination. The media is expelled via a pressurized air stream from any of a number of blast cleaning cabinets or machines. The item to be cleaned is subjected to the media/air stream and is cleaned by the non-abrasive cutting action of the impacting media particles.
- b. Capabilities - the individual media particles are irregular in configuration, with granular surfaces, incorporating sharp, angular edges for an extremely effective cutting, shearing, chipping action. This unique cleaning capability makes it possible for the media to remove surface buildup without etching, marring, or otherwise damaging most substrates, thus preserving vital surface integrity.

SPECIFIC PRODUCT DESCRIPTION:

	<u>POLYEXTRA</u>	<u>POLYPLUS</u>	<u>TYPE III</u>
Hardness, Moh Scale	3.0	3.5	4.0
Density (gms/cc)	1.2	1.5	1.5
Bulk Density (lbs/cu. ft.)	45-48	58-60	58-60
Operational Temp. Range	0°F-250°F	0°F-300°F	0°F-350°F
Moisture Content	<0.1%	<0.1%	<0.1%



SIZING AVAILABLE:

In Standard U.S. Sieve Sizes for each media

12-16 Mesh	.066-.045 inches
16-20 Mesh	.047-.030 inches
20-30 Mesh	.033-.021 inches
30-40 Mesh	.023-.015 inches
40-60 Mesh	.016-.009 inches
60-80 Mesh	.010-.006 inches

PACKAGING AVAILABLE

POLYEXTRA:	50 lb bags
	200 lb drums
POLYPLUS:	50 lb bags
	250 lb drums
TYPE III:	50 lb bags
	250 lb drums

OPERATING SUGGESTIONS:

Because of the physical characteristics and composition of the media, it works efficiently and performs most economically in conventional air blast systems at lower operating pressures than those generally used with traditional agricultural or mineral media. Recommended nozzle pressures are 30 p.s.i. to 60 p.s.i. Lower wheel speeds (lower linear velocities) of 1,000 - 1,500 r.p.m. are recommended for centrifugal wheel machines.

Care should be taken to finely tune the dust separation/media reclamation system to prevent the removal of good, reusable media from the blasting cycle. An efficient return classification system will provide material and process savings.

APPLICATIONS:

CLEANING

paint removal
molds
aircraft fuselage
ship bilges
engine components
buses

auto bodies
core boxes
truck wheels
heat exchangers
airline ovens
aircraft landing gear

pistons
propellor blades
boat hulls
armature wire
aircraft nose cones
fiberglass components

DEFLASHING

electronic components
lead frames
plastic moldings
alloy die castings
diodes

DEBURRING & SURFACE PREPARATION

aluminum housings
watch casings
zinc die castings
gear faces
alloy fuel tanks
plastic components

SYNOPSIS OF TESTING PERFORMED
BY U.S. MILITARY FACILITIES
EVALUATING

U.S. TECHNOLOGY CORPORATION
PLASTIC ABRASIVES

POLYEXTRA
POLYPLUS
TYPE III

SEPTEMBER 30, 1984

The plastic blast cleaning abrasives manufactured by U.S. Technology Corporation look to have a profound impact on the removal of surface coatings, buildup, and contaminants off surfaces that previously necessitated the use of toxic chemical solvents.

The Materials Are:

- POLYEXTRA
- POLYPLUS
- TYPE III

The U.S. Military in particular has shown tremendous interest and excitement in the use of the media for the removal of paint off aircraft. Components from a number of aircraft have been de-painted using this unique new method. They include: F-4, F-16, F-100, C-141, S-3, S-2, P-3, A-7, B-52, AWAC, H-3 and H-53 helicopters.

COMPONENTS

• rudders	• H-53 main gear box	• actuator assemblies
• flaps	• H-53 main gearbox housing	• ground support equip.
• slats	• H-53 sponson	• spindles
• engine blades and vanes	• H-53E stabilizer	• nose cone assemblies
• ailerons	• H-3 rotor hub	• C-5 landing gear
• outer wing panels	• H-3 sump housing	• wing attach fittings
• stabilators	• H-53 swashplate	• internal flap controls
• speed brakes	• H-3 tail rotor	• B-52 wheels
• vari-ramps	• H-53 floodboards	

SUBSTRATES

• magnesium	• aluminum
- magnesium anodize	- aluminum, Alclad
• titanium	- aluminum anodize
• steel	• carbon graphite
• Kevlar	• honeycomb
• fiberglass	

COATINGS REMOVED

• polyurethane	• structural adhesive	• polysulphide sealant
• epoxy polyamide	• corrosion buildup	• metallic spray
• rain erosion	• teflon dry film	• carbon buildup
• acrylic lacquer	• lubricants	• Koropon primer
• fuel sealants	• enamel	• fluorocarbon coatings

Some General Guidelines:

POLYEXTRA - paint/primer removal from composite (graphite epoxy) surfaces

POLYPLUS - paint/primer and resin removal off metal surfaces

TYPE III - sealant and structural adhesive removal

Optimal blasting pressure: 40 p.s.i

Cleaning rate: 2 to 4 sq. ft./min. with 1/2" nozzle

Selection of the proper media in the correct size range can result in substantial time savings over the presently used chemical stripping procedures.

**F-4 COMPONENT PARTS - REMOVED FROM AIRCRAFT
TIME COMPARISON CHART**

<u>COMPONENT</u>	<u>LABOR RATE (CHEMICAL)</u>		<u>MINUTES</u>	<u>LABOR RATE (PLASTIC BLASTING)</u>		<u>MINUTES</u>
RUDDER	3.60	=	216	0.26	=	16
INBD LE FLAP	2.81	=	168	0.36	=	22
SPOILER	0.67	=	40	0.24	=	14
OTED LE FLAP	2.81	=	168	0.31	=	19
AILERON	6.47	=	388	0.54	=	32

An in-service F-4 was stripped with the plastic blasting method at Hill AFB August 1984. The nose, canopy and afterburners were masked. Tape and plastic plugs were used to seal openings and drain holes. The engines were left in place with the inlets plugged. The plane was mounted on jacks with the landing gear up.

- RESULTS:
- the plane was stripped in 34 hrs. nozzle time plus 9 hrs. masking time. This compares with the chemical Standard Time of 338 hrs. plus 11 hrs. masking time.
 - the total time of 43 plastic blasting hrs. vs. 349 chemical stripping hrs. = 12% of the presently accepted norm.
 - the aircraft was finished in 1 calendar day vs. 7 days allocated for the chemical system
 - ingress of media occurred which later had to be vacuumed out
 - Alclad panels, which have tendency to be roughened and pitted, were first located with a small 3/16" nozzle with POLYPLUS 30/40 and then blasted before rest of aircraft was cleaned with larger 12/16 sieve size media
 - overall appearance of F-4 after blasting was called "superlative"

OTHER EXAMPLES:

- The entire exterior fuselage of an out-of-service F-100 was stripped with the plastic blasting method. The Standard Time to remove the paint from the 2069 sq. ft. surface with chemicals is 296 hrs. This same function was accomplished in 24 hrs. 50 min. with plastic blasting.
- A Coleman Tractor was stripped of 7 coats of enamel. The Standard Time for the present hand sanding method is almost 2 days. This was performed in 4 hrs. 14 min. with plastic blasting. (It is important to note that masking of the glass windows and rubber seals is not required for plastic blasting)
- The System Manager for the F-4 has approved the use of the media on all component parts removed from the F-4 aircraft. On most of these components the 12 to 1 ratio prevails.

- A Wingfold of an F-4 takes 8.5 hrs. to clean with chemicals. This same job can be accomplished in 45 min. with the plastic blast system. Hill AFB is now cleaning these wingfolds on a normal production basis using the plastic media.
- An F-18 actuator assembly requires 2.5 hrs. to clean with chemicals. The same component can be cleaned in 1.5 min. with plastic blasting. (Note: disassembly of the component is not required as it would be with chemicals)

CONSIDERATIONS:

The plastic blasting method is not a panacea, in that it is not the answer to all surface coating removal requirements. Negative results have occurred for certain applications:

- plastic blasting sometimes is not sufficient to remove severe corrosion products
- use of large sized media at high pressures can result in penetration through alclad surfaces and anodize coatings
- partial crack closure can occur on alclad
- it is possible to remove cadmium if blasting pressures are too high
- damage can occur to certain types of fiberglass and thin honeycomb if the process is not carefully controlled

However, properly utilized, the plastic blasting process offers immediate labor, time, equipment, material, and energy savings in the many applications for which the material's use is appropriate.

It is the stated objective of the Department of Defense that by year end 1986 all chemical solvents will be eliminated from waste products. The plastic blasting system can be a major factor in reducing the contaminants presently produced by the military industrial complex. Military estimates indicate that aircraft stripping wastes can be eliminated by a factor of 75% - 99% with the proper utilization of this method.

WHY BLAST WITH PLASTIC ABRASIVES

- eliminate chemical contamination
- eliminate most air contamination
- eliminate water contamination and clean up
- reduce personnel exposures to chemical hazards
- reduce man hours
- reduce consumption of commodities
- reduce energy requirement
- reduce aircraft flow time
- improve readiness posture

F-4 COMPONENT PARTS - REMOVED FROM AIRCRAFT

TIME COMPARISON CHART

<u>COMPONENT</u>	<u>CLEANING TIME MINUTES (CHEMICAL)</u>	<u>CLEANING TIME MINUTES (DRYSTRIP)</u>
RUDDER	216	16
INBD LE FLAP	168	22
SPOILER	40	14
OTBD LE FLAP	168	19
AILERON	388	32
WINGFOLD	525	54
STABILATOR	589	55

- OTHER EXAMPLES -

<u>ITEM</u>	<u>CLEANING TIME (CHEMICAL)</u>	<u>CLEANING TIME (DRYSTRIP)</u>
F-100 AIRCRAFT	300 HRS	37 HRS
F-4 AIRCRAFT	340 HRS	39 HRS
COLEMAN TRACTOR	40 HRS	4 HRS
P-8 PUMPERTRUCK	52 HRS	5 HRS
F-18 ACTUATOR ASSEMBLY	2.5 HRS	1.5 MIN

DC-9 COMPONENT PARTS - REMOVED FROM AIRCRAFT

TIME COMPARISON CHART

<u>COMPONENT</u>	<u>CLEANING TIME MINUTES (CHEMICAL)</u>	<u>CLEANING TIME MINUTES (DRYSTRIP)</u>
FLAP HINGE FITTING	240	5
FRWD AIR STAIR STEP	120	5
OXYGEN BOTTLE	120	10
SPOILER CAM	60	2
DOUBLE SEAT FRAME	240	15
	(time savings for 1 complete aircraft set is 220 hrs.)	
NOSE WHEEL	60	2

Total number of items tested: 43

Items failed: 1

Items with no time savings: 4

Total number of items with
appreciable time savings: 38

Evaluation Results

OVERALL TIME SAVINGS ACHIEVED: 93%

F-4 DIRECT COST COMPARISON (PROJECTED)

CHEMICAL VS DRYSTRIP

	<u>CHEMICAL</u>	<u>DRYSTRIP</u>
CLEANING MAN HRS.	341	39
LABOR RATE	\$40.00/hr.	\$40.00/hr.
TOTAL LABOR COST PER AIRCRAFT	\$13,640	\$1,560
LABOR COST/SQ. FT. (2069 Sq. Ft.)	\$6.59/Sq. Ft.	\$0.75/Sq. Ft.
MATERIAL CONSUMPTION PER AIRCRAFT	\$2,460 (400 gal @ \$6.15/gal)	\$308.00 (140 lbs @ \$2.20/lb)
MATERIAL COST/SQ. FT. (2069 Sq Ft)	\$1.19/Sq. Ft.	\$0.15/Sq. Ft.
WATER TREATMENT COSTS @ \$9.71/1,000 gal (no phenols)	\$194.20 (20,000 gal/aircraft)	0
WASTE DISPOSAL COSTS @ \$100/dt. (secured landfill)	0	\$200.00
ENERGY COSTS (hanger ventilation)	\$1,719 (72 hrs floor time) (400 hp. vent)	\$72.00 (8 hrs floor time) (150 hp. vent)
ENERGY COSTS (direct operating)	0	\$449.00 (4 nozzles (.5") @ 160 cfm/nozzle)
TOTAL COST	\$18,013.20	\$2,589.00

GENERAL SERVICES ADMINISTRATION

FEDERAL SUPPLY SERVICE

AUTHORIZED FEDERAL SUPPLY SCHEDULE CATALOG



BLAST CLEANING MEDIA

1. Special Item Numbers:

NIS-G-5985

NIS-G-7191

NIS-G-8556

See attached data
sheets for details
on each product.

2. Maximum Order Limitation: \$25,000

3. Minimum Order: 50 lb. bag

4. Delivery Area: 48 contiguous states and Washington, D.C.

5. Point of Production: Danielson, Windham County, CT

6. Net Price: \$1.70 per lb. F.O.B. Origin

7. Prompt Payment Terms: net 30

8. Quantity Volume Discount:	\$ 5,001 - \$10,000	1/2%
	\$10,001 - \$20,000	1-1/2%
	\$20,001 - \$25,000	2%

9. Time of Delivery: 30 days

10. F.O.B.: origin (Danielson, CT)

11. Warranty Provision: see inside data sheets

12. Payment Address:

**U.S. TECHNOLOGY CORPORATION
P.O. Box 302
Worcester, MA 01614**

NEW ITEM INTRODUCTORY SCHEDULE

FSC CLASS: 5350

CONTRACT NUMBER: GS-OOF-79342

CONTRACT PERIOD: 4/24/85 - 4/24/86

BUSINESS SIZE: SMALL

CONTRACTOR - ORDERING ADDRESS

**U.S. TECHNOLOGY CORPORATION
328 KENNEDY DRIVE
PUTNAM, CT 06260
Telephone: (800) 243-1842
(203) 928-2707**

U.S. Technology Corporation
(A subsidiary of U.S. Plastic and Chemical Corp.)
328 Kennedy Drive
Putnam, Conn. 06260
Tel. 203-928-2707
Toll Free 800-243-1842

Meet your surface finishing and cleaning needs with three different grades of



BLAST CLEANING MEDIA

If your operation includes deflashing, deburring, descaling, or any type of surface conditioning, you should consider the advantages of **US Blast Cleaning Media**.

EDGE AHEAD... with the sharp, angular cutting edges of **US Media**. The granular shape of individual particles enables **POLYEXTRA**, **POLYPLUS**, and **TYPE III** to quickly and efficiently clean with a unique shearing,

chipping and cutting action that rapidly removes surface contamination and build-up that other abrasives cannot effectively remove. Tough cutting edges permit maximum productivity at low particle velocity.

To satisfy varied requirements, a wide range of cleaning capability and aggression is provided by these three products for the best possible match of media to application.

POLYEXTRA™

The Original Koppers Blast Cleaning Media.

Introduced in 1978, the media is designed for use in soft abrasive finishing and deflashing. Where surface tolerances are critical, and the integrity of the substrate cannot be compromised, **POLYEXTRA** is the

answer. It has found tremendous acceptance as a replacement for walnut shell and apricot pit, particularly for electronic component cleaning.

POLYPLUS™

A more aggressive grade of US Media.

Next on the scale of aggression **POLYPLUS** is harder, denser, and faster-acting than **POLYEXTRA**. It is applicable for a great variety of light industrial uses. This media fills the need for a more abrasive material

that still will not be too harsh or damaging for most surface finishing applications. It is designed to be used at low p.s.i. settings for optimum performance with low energy consumption.

TYPE III™

The most aggressive US Media.

This material is an extremely aggressive and abrasive media. It approaches the cleaning capabilities of much more harsh, metallic and mineral abrasives such as aluminum oxide. Yet, because it is

a plastic media, it will not harm blast cleaning equipment. **TYPE III** is very fast-acting, even at reduced p.s.i. settings. It is particularly effective in many alloy metal finishing and deburring applications.

If your finishing procedures use:

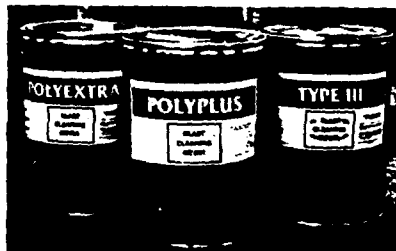
- ▶ glass beads
- ▶ aluminum oxide
- ▶ walnut shell
- ▶ apricot pit
- ▶ chemical solvents

If these products are:

- ▶ ineffective in performance
- ▶ dusty and dirty
- ▶ damaging to equipment and parts
- ▶ inconsistent in quality
- ▶ hazardous to use or dispose of

Then consider the edge you'll gain with **US Media**:

- ▶ cleaner parts
- ▶ less rejects
- ▶ greater throughput
- ▶ higher productivity
- ▶ SAVINGS



U.S. Technology Corporation
(A subsidiary of U.S. Plastic and Chemical Corp.)
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BLAST CLEANING MEDIA

POLYEXTRA™

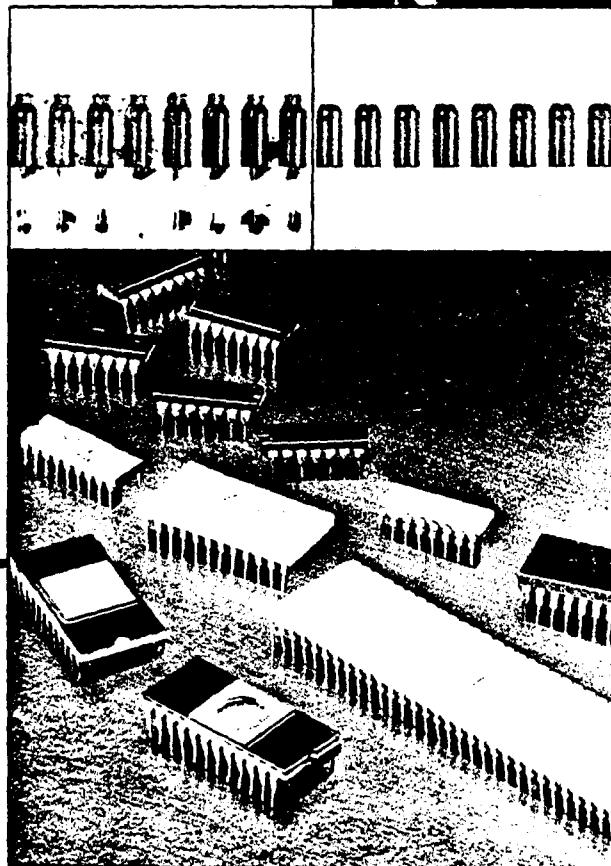
The original POLYEXTRA blast cleaning media is a soft delasshing and cleaning plastic abrasive. Due to its composition and sharp, angular surface characteristics, the media has excellent cutting qualities, cleans efficiently, but will notpeen or mar material substrates.

POLYEXTRA is a carefully manufactured product that is uniform from batch to batch, in contrast to agricultural media, for instance, that often varies in consistency from one lot to another.

POLYEXTRA presents no storage problems. Concern over spoilage, rodent attraction, mildew and bacteria growth is eliminated. Also, the media does not create the type of dust and oily residue problem traditionally associated with agri-media.

POLYEXTRA is consistent, is constant in character, is highly reusable and is very efficient.

POLYEXTRA is fast and efficient, yet is designed to maintain the integrity of the finished surface. It is an excellent media in applications where critical dimensions and tolerances must be maintained while removing surface contamination.



On a scale of comparative aggression, POLYEXTRA is the mildest in the line of US Blast Cleaning Media products.

Agri-Media (Walnut Shell) **POLYEXTRA™ POLYPLUS™ TYPE III™** Mineral Abrasives (Aluminum Oxide)
less aggressive more aggressive

New Item Introductory Schedule
GSA Contract No. GS-00F-79342
4/24/85 - 4/24/86

SPECIAL ITEM NO.
NIS-G-5985

Available Through:
GSA Federal Supply Service
NIIS Contract No. GS-00F-79342

APPLICATIONS

Encapsulated electronic components: Will not damage delicate parts or mar surfaces. Leaves product surface clean and dust free, ready for identification printing and soldering.

Plastic molded parts: Effectively cleans flash off parting lines. Cleans surfaces without harming the part. Cleans mold without damage.

Aircraft maintenance: Removes paint layers and coatings for inspection/recoating. Cleans precision parts with no base metal removal.

Lead frames: Prepares leads for easier and more uniform tinning and coating procedures. Will not impinge the surface while removing flash and resin smear.

Engine maintenance: Removes carbon, sludge and gum deposits from internal combustion and diesel engines without causing surface damage.

General deburring: Removes light burrs from miscellaneous materials without surface distortion.

BENEFITS

Cost savings: Reduced costs are realized from low media consumption and greater product feed-thru rates at lower PSI.

Processing savings: The extra costs associated with agricultural media for inspection, degreasing and wiping are lessened. Entire post cleaning procedures can be eliminated from the production cycle.

Consistent quality: Media does not vary from batch to batch as with various agri-media. The material is constant and consistent. It is manufactured, not grown.

Easy storage: No special storage or deterioration prevention requirements are necessary.

Packaging: POLYEXTRA



50 lb. bags
200 lb. drums

GUARANTEE

Material is guaranteed to comply with published specifications concerning mesh size, specific gravity, shape, hardness, moisture content, storage stability and operating temperature range.

Responsibility is disclaimed in the handling, use and storage of this material since it is beyond the scope of our control.

PHYSICAL CHARACTERISTICS

Hardness, Mohs Scale	3
Moisture Content	<0.1%
Specific Gravity	1.15-1.25
Bulk Density	45-48 lbs./cu. ft.
Operational Temp. Range	0°F-250°F
Color	white to gray (varied)
Chemical Nature	flammable, hydrophobic, inert to mild acid or alkali, non-biodegradable
Particle Shape	irregular, granular, with sharp angular edges

SPECIFICATIONS

The media is graded in the following Standard U.S. Sieve Sizes

Sieve Size	Inches	(mm)
12-16	.066-.045	(1.68-1.14)
16-20	.047-.030	(1.19-.76)
20-30	.033-.021	(.84-.53)
30-40	.023-.015	(.58-.38)
40-60	.016-.009	(.41-.23)
60-80	.010-.005	(.25-.13)

Note:

The actual size as stated in inches will apply to at least one diagonal direction of any particle. Due to irregular shape, as much as 5% fines may be contained in any grade size.

ORDERING INSTRUCTIONS FOR POLYEXTRA™

Please order by TYPE and SIEVE SIZE in either 50 lb. bags or 200 lb. drums.

Type	Sieve Size
PE	12-16
PE	16-20
PE	20-30
PE	30-40
PE	40-60
PE	60-80

11-16

SPECIAL ITEM NO.
NIS-G-5985

U.S. Technology Corporation
(A subsidiary of U.S. Plastic and Chemical Corp.)
328 Kennedy Drive
Putnam, Conn. 06260
Tel. 203-928-2707
Toll Free 800-243-1842



BLAST CLEANING MEDIA

POLYPLUS™

POLYPLUS is a granulated plastic blast cleaning media that is significantly denser, harder and more aggressive than most other soft abrasives. Particle shape is sharp and angular. This special configuration enables POLYPLUS to clean with an enhanced cutting, shearing and chipping action to remove surface residue and buildup that other soft abrasives are not able to clean.

POLYPLUS is considerably more aggressive than commonly used agricultural media. This media is often the answer when a more abrasive material is required that still will not be too harsh or damaging for most surface finishing applications. POLYPLUS is designed to be used at low pressure settings. Proper set up and utilization will yield significant savings due to decreased energy consumption and increased cleaning per unit of media.

POLYPLUS is easy to use and handle. No special storage precautions are necessary. The media is clean in application and virtually dust free. No oily residue is created that is common with the use of most other media in this hardness range.



On a scale of comparative aggression with the other US Blast Cleaning Media products, POLYPLUS lies between POLYEXTRA and the aggressive TYPE III.

Media (nut Shell) **POLYEXTRA™ POLYPLUS™ TYPE III™** Mineral Abrasives (Aluminum Oxide)
less aggressive > more aggressive

New Item Introductory Schedule
GSA Contract No. GS-00F-79342
4/24/85 - 4/24/86

SPECIAL ITEM NO.
NIS-G-7191

11-17

Available Through:

GSA Federal Supply Service
NIIS Contract No. GS-00F-79342

APPLICATIONS

Are glass beads too damaging? Is polycarbonate ineffective?
Walnut shells aren't aggressive enough? Then POLYPLUS may be
the answer to your finishing needs for...

- ▶ zinc die castings
- ▶ marine equipment
- ▶ light deburring
- ▶ paint removal
- ▶ electronic components
- ▶ plastic deflashing
- ▶ aircraft fuselage
- ▶ metal surface conditioning
- ▶ surface decontamination

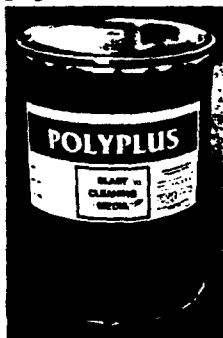
POLYPLUS is designed to be effective in a wide range of uses, from
electronic component deflashing to light industrial finishing.

SAVINGS

Durable composition and sharp-edged configuration enable this
media to clean quickly at low pressure settings, thereby reducing
cost. Savings are realized from:

- ▶ decreased media consumption
- ▶ faster product throughput
- ▶ reduced compressor needs
- ▶ lower energy consumption
- ▶ longer equipment life

Packaging: POLYPLUS



50 lb. bags
250 lb. drums

GUARANTEE

Material is guaranteed to comply
with published specifications
concerning mesh size, specific
gravity, shape, hardness, moisture
content, storage stability, and
operating temperature range.

Responsibility is disclaimed in
the handling, use and storage of
this material since it is beyond the
scope of our control.

PHYSICAL CHARACTERISTICS

Hardness, Mohs Scale	3.5
Moisture Content	<0.1%
Specific Gravity	1.5
Bulk Density	58-60 lbs./cu. ft.
Operational Temp. Range	0°F-300°F
Color	white to dark gray (varied)
Chemical Nature	self extinguishing, hydrophobic, inert, non-biodegradable
Particle Shape	irregular, granular, with sharp angular edges

SPECIFICATIONS

The media is graded in the following Standard U.S. Sieve Sizes

Sieve Size	Inches	(mm)
12-16	.066-.045	(1.68-1.14)
16-20	.047-.030	(1.19-0.76)
20-30	.033-.021	(0.84-0.53)
30-40	.023-.015	(0.58-0.38)
40-60	.016-.009	(0.41-0.23)
60-80	.010-.005	(0.25-0.13)

Note

The actual size as stated in inches will apply to at least one
diagonal direction of any particle. Due to irregular shape,
as much as 5% fines may be contained in any grade size.

ORDERING INSTRUCTIONS FOR POLYPLUS™

Please order by TYPE and SIEVE SIZE in either 50 lb. bags or
250 lb. drums.

Type	Sieve Size
PP	12-16
PP	16-20
PP	20-30
PP	30-40
PP	40-60
PP	60-80

11-18

SPECIAL ITEM NO.
NIS-G-7191

U.S. Technology Corporation

(A subsidiary of U.S. Plastic and Chemical Corp.)

328 Kennedy Drive
Putnam, Conn. 06260
Tel. 203-928-2707
Toll Free 800-243-1842



BLAST CLEANING MEDIA

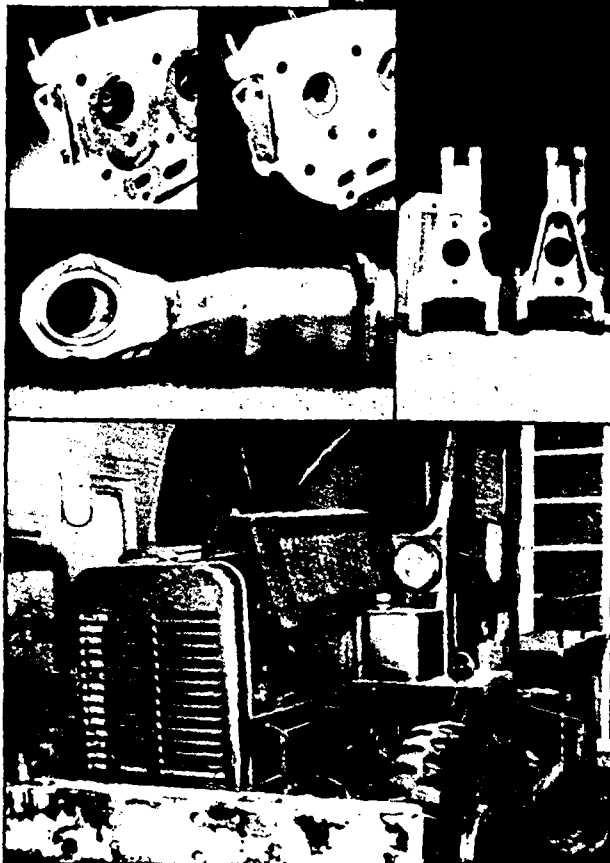
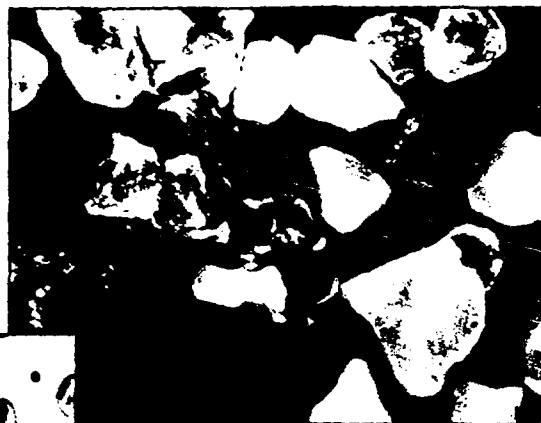
TYPE III™

...The most aggressive US Media...

TYPE III is a unique, extremely aggressive, synthetic plastic abrasive that approaches mineral and metallic abrasives in its surface finishing capabilities. Fast acting and durable, TYPE III can be the answer to your finishing needs for those very difficult to clean materials where no other synthetic abrasive or agricultural media has properly worked before or where hard abrasives have proven to be overly harsh or damaging.

It is important to note that, despite its high degree of aggression, TYPE III is a plastic media and, as such, is not harmful to blast cleaning equipment or cabinetry. It does not wear out machinery, thereby realizing substantial savings by eliminating the need to purchase expensive replacement parts.

No other abrasive matches the uniquely controllable aggression of TYPE III. The sharp angular surface configuration of the media particles provides the most effective cleaning action possible for maximum efficiency with minimum media consumption.



On a scale of comparative aggression, TYPE III is more aggressive than the other US Blast Cleaning Media products, POLYEXTRA and POLYPLUS.

Agri-Media (Walnut Shell) **POLYEXTRA™ POLYPLUS™ TYPE III™** Mineral Abrasives (Aluminum Oxide)

less aggressive

more aggressive

New Item Introductory Schedule
GSA Contract No. GS-00F-79342
4/24/85 - 4/24/86

11-19

SPECIAL ITEM NO.

NIS-G-8556

Available Through:
GSA Federal Supply Service
NIIS Contract No. GS-00F-79342

EXAMPLES OF USES

Surface Residue Removal

- ▶ flash from metal die castings
- ▶ burrs off gear face surfaces
- ▶ surface build-up off aircraft components
- ▶ polyamid coating off armature wires
- ▶ paint from ships hulls
- ▶ carbon deposits off engine parts

Surface Conditioning

- ▶ metal surfaces: pre-treatment/cleaning/deflashing prior to plating
- ▶ plastic composite parts: to roughen surface for better adhesive application
- ▶ aluminum computer components: to produce attractive matte finish
- ▶ plastic controls: to prepare surface for improved paint adhesion
- ▶ marine equipment: reconditioning by removal of rust and corrosion

DO YOU...

- ▶ find aluminum oxide is too harsh, but nothing else works
- ▶ use dangerous and expensive chemicals that are difficult to use and dispose of
- ▶ spend a lot of money to replace machine parts that media wears out
- ▶ want to clean and finish your parts quicker and better

THEN

TRY TYPE III, YOU WILL FIND THAT...

- ▶ it is easy to use. There are no storage problems. Spent media is easily disposed of.
- ▶ money will be saved by eliminating the need to purchase equipment worn out by media
- ▶ it can be continuously recycled
- ▶ it's extremely effective at low p.s.i. settings

Packaging: TYPE III



50 lb. bags
250 lb. drums

GUARANTEE

Material is guaranteed to comply with published specifications concerning mesh size, specific gravity, shape, hardness, moisture content, storage stability, and operating temperature range.

Responsibility is disclaimed in the handling, use and storage of this material since it is beyond the scope of our control.

PHYSICAL CHARACTERISTICS

Hardness, Mohs Scale	4
Moisture Content	<0.1%
Specific Gravity	1.5
Bulk Density	58-60 lbs./cu. ft.
Operational Temp. Range	0°F-350°F
Color	multicolored; may vary
Chemical Nature	self extinguishing hydrophobic, inert non-biodegradable
Particle Shape	irregular, granular, with sharp angular edges

SPECIFICATIONS

The media is graded in the following Standard U.S. Sieve Sizes

Sieve Size	Inches	(mm)
12-16	.066-.045	(1.68-1.14)
16-20	.047-.030	(1.19-.76)
20-30	.033-.021	(.84-.53)
30-40	.023-.015	(.58-.38)
40-60	.016-.009	(.41-.23)
60-80	.010-.005	(.25-.13)

Note

The actual size as stated in inches will apply to at least one diagonal direction of any particle. Due to irregular shape, as much as 5% fines may be contained in any grade size.

ORDERING INSTRUCTIONS FOR TYPE III™

Please order by TYPE and SIEVE SIZE in either 50 lb. bags or 250 lb. drums.

Type	Sieve Size
TP	12-16
TP	16-20
TP	20-30
TP	30-40
TP	40-60
TP	60-80

11-20

SPECIAL ITEM NO.
NIS-G-8556

Clemco's Remarkable

NOVA*

**The world's most advanced abrasive
blast and recovery system!**

NOVA*

The ultimate performance system!

Classifier
Spent abrasive is drawn by the pick-up tool into the Classifier. Large, reusable abrasive falls out of the air stream into the hopper below. Smaller materials (residual dust, fines, etc.) are carried out the top outlet, moving on to the Dust Collector.

Pick-Up Tools
The bulk Pick-Up tool is the highest volume mover of the four tools. Optional tools include the Flare with a flat, wide inlet for clearing low level material off the operating surface. The Crevice tool fits into small or narrow areas, and the Brush tool is designed to clean up dust that is left on the surface to be coated. Each tool has an adjustable air intake to maximize abrasive flow. The bulk and flare tools are standard.

Apollo Operator Safety Gear

Climate controlled, filtered air is fed to the Class A, OSHA/NIOSH approved protective helmet. Its double shell exceeds ANSI hard hat standards. Apollo is unequaled in the world market for safety, comfort and flexibility. Leather-faced, cotton-backed blast suit and leather gloves complete the NOVA Operator package.

Dust Collector
As dust-laden air enters the Collector, the dust collects on the outer surfaces of the cartridges (2), and clean air is drawn through the top outlet of the lid to the VPR. Timed air pulses automatically keep the cartridges clean and at peak efficiency.

Vacuum Producer (VPR)
NOVA's vacuum producer generates the operating vacuum for all recovery components. The NOVA design prevents abrasive from going through the VPR. VPR's silencer reduces operating noise levels. This equipment is available in either 150 or 290 CFM as required.

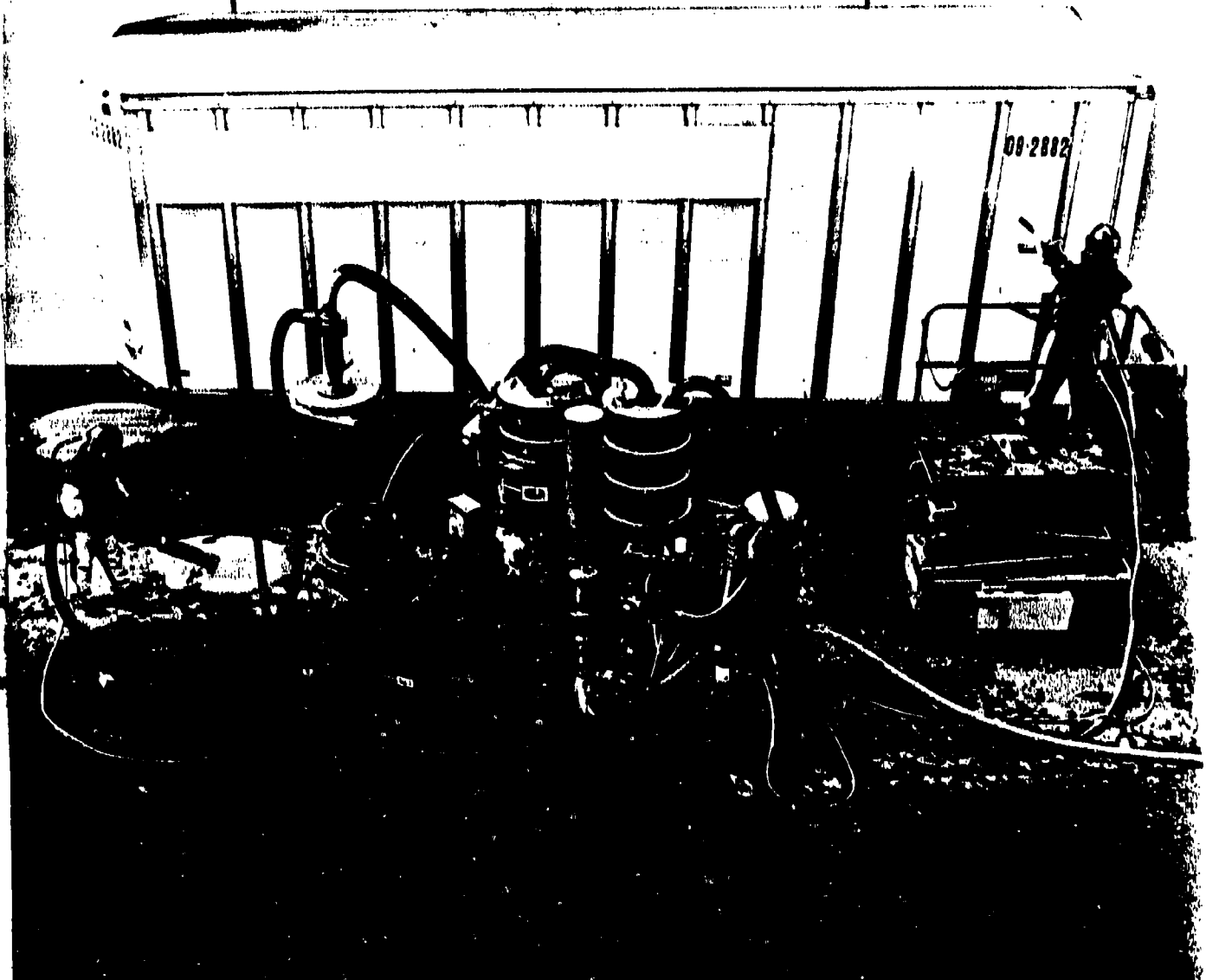
Clemco Blast Machine
This high production, pressure Blast Machine has a special 60° conical bottom allowing uninterrupted flow of all sophisticated abrasives. This benchmark blast machine features unrestricted formed piping with compression fittings and ball valves, pneumatically operated

remote controls featuring an abrasive metering pinch valve that directs abrasive into the air stream at a peak efficient 45°. It is operator controlled with an abrasive cut-off switch and has a pressure regulator to tailor precise air pressure requirements.

Vibrating Screen
Located under abrasive hopper, all abrasives pass through screen to remove debris.

Chassis
Portable or stationary options.

Air Distribution Tank



Specific Applications

NOVA is a unique system that blasts, recovers, reclaims and recycles sophisticated abrasives such as glass beads, aluminum oxide, agricultural abrasives and the newly introduced plastic abrasives.

NOVA, using these economical, reusable abrasives at a lower than normal blasting pressure, strips and cleans surfaces heretofore difficult if not impossible to blast clean.

Surfaces such as aluminum, titanium, stainless steel, fiberglass, kevlar and other composites, all respond quickly and cleanly to NOVA's "touch."

Surfaces like those of aircraft have been routinely cleaned chemically—a costly, time consuming, environmentally

stripped and cleaned aircraft at an amazing rate of speed without damage to metal or composite surfaces.

Numerous applications for NOVA include automotive parts,

boats,

turbines,

molds,

vehicle bodies,

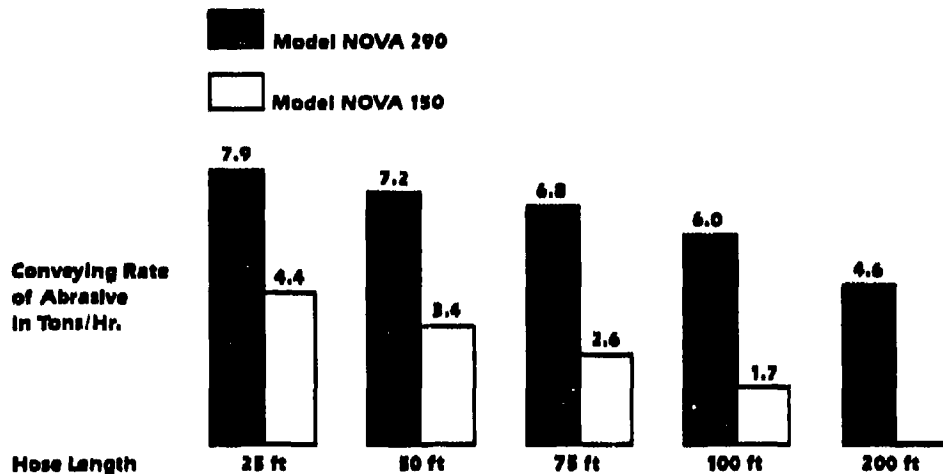
signs,

containers,

rapid transit equipment,

the list grows!

Specifications



Typical conveying rates for sophisticated abrasives such as aluminum oxide, agricultural, glass beads, plastics, etc.

Models

NOVA 290S—Stationary 290 cfm Vacuum System

NOVA 290P—Portable 290 cfm Vacuum System

NOVA 150S—Stationary 150 cfm Vacuum System

NOVA 150P—Portable 150 cfm Vacuum System

Dimensions

Skid Mounted Unit

Width 4'6" (137 cm)
Length 14'6" (442 cm)
Height 11'3" (343 cm)

(Portable unit dimensions vary slightly.)

For transportation, overall height can be reduced to 8'.

Weight 2,900 lbs (1315 Kg) Skid mounted.
3,400 lbs (1542 Kg) Portable.

Standard NOVA Components

Blast Machine:

Pressure Regulator with Gauge

Supa Extra Flexible Blast Hose

Clemlite Nozzle

Nylon Couplings

Apollo Air-Fed Helmet

60° Conical bottom

Pinch Tube Metering Valve

Single Vibrating Screen

Remote Controls

Helmet Air Filter

Blast Suit—Leather Gloves

Climate Control Tube

Moisture Separator

Other:

Liquid Filled Pressure Gauges

Hose Racks

Forklift Slots & Lifting Eyes

50' of 3" Pick-Up Hose

3" Bulk Abrasive Vacuum Nozzle

3" Flare Abrasive Vacuum Nozzle

Accessories

Remote VPR Actuator

Remote Pot Pressurizing & Depressurizing

Vibrating Screen: 3 Deck, 2 Screens (electric powered)

Explosion-proof motors

CMA (Carbon Monoxide Alarm)

Hoses and Tool Package

Compressed Air Requirements

Vacuum Producer: 290 cfm or 150 cfm @ 100 psig (6.8 bar)

Operator Safety Equipment: 20 cfm @ 80 psig (5.4 bar)

Vibrating Screen: 5–10 cfm @ 40–80 psig (2.7–5.4 bar)

Dust Collector: 2–3 cfm @ 100 psig (6.8 bar)

Blast Nozzle: Based on orifice size.

Power Requirements

Voltage: 110 VAC (12 VDC on request)

GEMINI

Complementing NOVA, Clemco's GEMINI system allows "tailoring" particular components to specific applications.

GEMINI is ideal for the retrofit of existing enclosures to complete blast facilities. Clemco's complete line of blast rooms, dust collecting systems and associated units is available.

Complete engineering design assistance on customized applications is available from Clemco without charge.



CLEMCO

Post Office Box 7680
San Francisco, CA 94120



NO
SMOKING

PAULI & HENTZ

Aerobent
VISIO



Pauli & Griffin PRAMTM Machines

Portable De-Painting Machines with vacuum recovery and automatic media recycling—Engineered for optimum production with U.S. Plastic reclaimable media

A New Media

The revolutionary U.S. Plastic Blast Cleaning Media has proven it will aggressively remove paint, sealant, and coatings from aircraft and other aluminum surfaces without damaging the surface cleaned. The U.S. Plastic Media also cleans seven times faster, in terms of labor hours expended, than conventional chemical stripping, and eliminates the serious hazardous waste disposal problem of the chemicals and water used for stripping.

P&G PRAM Portable Cleaning Machines

Through its Aeronautical Products Division Pauli & Griffin has conducted extensive tests with the new U.S. Plastic Blast Cleaning Media, and has developed a full line of cleaning and depainting equipment specially engineered for optimum production with the light, plastic media.

Advantages of P&G PRAM Spot Depainting Machines

- Dust free cleaning or depainting in general maintenance areas without interfering with other operations or personnel.
- Immediate start-up of cleaning or depainting operation, while major blast facility is under construction.
- Quick, easy small job cleaning of selected parts or limited areas of larger workpieces.
- Touch up cleaning anywhere, after aircraft or other large workpiece has left major cleaning facility.

PRAM Model 45 High Production System

The P&G PRAM Model 45 combines the benefits of high production, direct pressure cleaning and depainting with automatic vacuum recovery and cleaning and recycling of the media. The PRAM Model 45 consists of an external gun assembly, conveying hoses, cyclone reclaimers, special PRAM pressure vessel with 60° conical bottom, dust collector and 320 cfm air operated vacuum pump, all mounted on a steel wheeled chassis.

Principle of Operation

Operator controls cleaning operation at external blast gun with fast-acting Feathertouch® remote control. Air/media mixture is accelerated through a venturi nozzle, and directed to the work surface. Media, dust and debris are contained within the external gun, and pneumatically conveyed to the cyclone reclaimers.

The controlled cyclonic action separates the plastic media and heavy debris from dust and other fines. A fine-tunable, two stage air wash system brings air into the cyclone to improve the separation of fines from the media. The dust and fines are pulled from the center of the cyclone and conveyed to the dust collector with high efficiency tubular dust bags. The bags filter return air down to 1 micron particles.

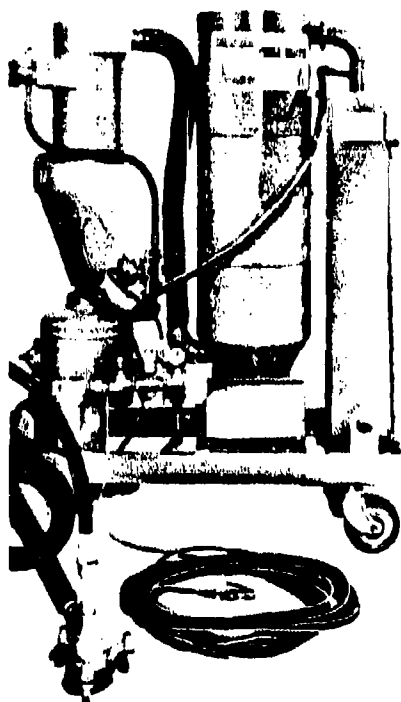
Meanwhile, cleaning media and heavy debris fall to a vibrating screen, which contains the debris, and allows only reusable, correctly sized media to fall through to the storage hopper, located over the PRAM pressure vessel.

Each time the operator stops blasting, the PRAM machine exhausts automatically, and the media in the hopper refills the machine.

System Components

- 1 ft 3 ASME coded PRAM pressure vessel with specialized aeration and fluidizing section; 60° conical bottom for smooth, even media flow into delivery air stream.
- Air entry system with moisture separator, pressure regulator and gauge.
- Cyclone reclaimers with two stage, fine-tunable air wash system, engineered specifically for the density of plastic media.
- 1 ft 3 media hopper with vibrating screen.
- External blast gun with 5/16" tungsten carbide, venturi nozzle; nylon brush to contain dust, plus three caster wheels on removable ring to facilitate movement along work surface.
- Totally enclosed 320 cfm dust collector with 7 tubular dust bags, powered by air operated vacuum pump.
- 25 ft. hose assembly, consisting of media hose, vacuum hose, and twin line control cable with patented Feathertouch® remote control.
- Wheeled chassis for easy mobility around work area.

See last page for more detailed information.



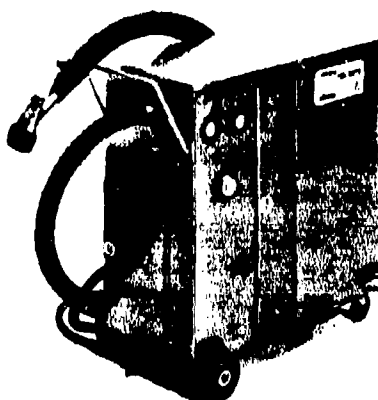
PRAM Model 45

PRAM Model 41

The PRAM Model 41 is a small, compact cleaning and depainting machine that offers the same vacuum return, dust free blasting of the Model 45, and is ideally suited for tight spot blasting, where a lower production rate can be tolerated.

Operation

The external blast gun has a 3/16" air jet and 3/8" tungsten carbide nozzle. Compressed air flowing through the air jet pulls the cleaning media into the gun, and directs it through the nozzle at the work surface. All media, dust and debris are contained within the blast gun, and pneumatically conveyed to the cyclone reclaiming for cleaning and separating dust and debris from the good, reusable media. With the PRAM 41, correctly sized, reusable media constantly replenishes the hopper during the depainting operation.



PRAM Model 41

System Components

- External blast gun with 3/16" air jet and 3/8" tungsten carbide nozzle, easy start/stop control valve, replaceable nylon brush.
- 20 ft. hose assembly, consisting of air hose, media supply hose and reinforced vacuum recovery hose.
- Totally enclosed dust collector with 9 tubular dust bags.
- Cyclone separator with vibrating screen.
- Media hopper with steep conical bottom and fluidizing section for smooth, even media flow into the feed tee and cleaning stream.
- Storage box for spare brushes, nozzles and supplies.
- Compact, wheeled chassis and handle for easy mobility through tight spaces.
- Choice of air operated or electric motor powered vacuum pump.
- Air line moisture separator, air pressure regulator and gauge, and air supply line pressure gauge.

Typical Applications

P&G PRAM Series Machines and U.S. Plastic Blast Cleaning Media:

Aircraft/Components, Military Installations

- Removes surface coating or build-up without damage to substrate.
- Allows precise control over layers removed, while preserving substrate layers of alclad, anodizing, cadmium plating, etc.

Electronics/Instrumentation

- Deflashes epoxy encapsulation 5 to 10 times more effectively than agrimedia, with no need to mask individual encapsulations or critical components.

Auto Bodies

- Removes paint fast, without need to mask glass, rubber or chrome surfaces, and without damage to surface.

Mold Cleaning

- Removes surface buildup without changing mold tolerances.

Die Castings

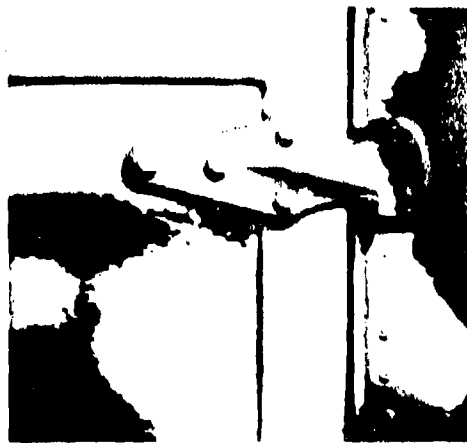
- Deflashes parts without affecting critical surface dimensions.

Actuator Assemblies

- Cleans in far less time than chemical stripping, with no need to disassemble.

Copper Armature Wires

- Removes polyamide coating without damaging wire; does not cause rapid oxidation like metallic abrasives.



Ordering Information/Specifications

Model:	PRAM 45	PRAM 41A	PRAM 41E
Stock No.:	039-000	038-010	038-000
Length:	68 in. (173 cm)	35 in. (89 cm)	35 in. (89 cm)
Width:	36 in. (91 cm)	19 in. (48 cm)	19 in. (48 cm)
Height:	86 in. (218 cm)	35 in. (89 cm)	35 in. (89 cm)
Dust Collector:	320 CFM (9.1 m ³ /min.)	120 CFM (3.4 m ³ /min.)	110 CFM (3.1 m ³ /min.)
Dust Filter Bags:	7 tubular	9 tubular	9 tubular
Filter Area:	35 sq. ft. (3.3 m ²)	16 sq. ft. (1.5 m ²)	16 sq. ft. (1.5 m ²)
PRAM Vessel:	1 cu. ft. (.03 m ³) ASME coded, with 60° cone and fluidizing section	NONE	NONE
Media Hopper:	1 cu. ft. (.03 m ³)	121.4 cu. in. (1989 cm ³) with fluidizing section	121.4 cu. in. (1989 cm ³) with fluidizing section
Vacuum Pump:	Air Powered	Air Powered	Two 1 HP, 120v, 60 Hz 1 Ph 15.8 amp
Cleaning Hose:	¾ in. ID x 25 ft. (19 mm x 7.6 m)	¾ in. ID x 20 ft. (16 mm x 6.1 m)	¾ in. ID x 20 ft. (16 mm x 6.1 m)
Vacuum Hose:	2 in. x 25 ft. (51 mm x 7.6 m)	1½ in. x 20 ft. (41 mm x 6.1 m)	1½ in. x 20 ft. (41 mm x 6.1 m)
Control Line:	25 ft. (7.6 m) with Feathertouch® control	¾ in. ID x 20 ft. with trigger valve (13 mm x 6.1 m)	¾ in. ID x 20 ft. with trigger valve (13 mm x 6.1 m)
Nozzle:	5/16 in. (8 mm) Tungsten Carbide Venturi	¾ in. (10 mm) with 3/16 in. (5 mm) air jet	¾ in. (10 mm) with 3/16 in. (5 mm) air jet
Nominal Cleaning Rate:	3 sq. ft. (.28 m ²) per minute	72 sq. in. (465 cm ²) per minute	72 sq. in. (465 cm ²) per minute
Air Consumption:			
@40 psi (2.8kg/cm ²)	196 CFM (5.5 m ³ /min.)	78 CFM (2.2 m ³ /min.)	28 CFM (.8 m ³ /min.)
@60 psi (4.2kg/cm ²)	287 CFM (7.6 m ³ /min.)	86 CFM (2.4 m ³ /min.)	38 CFM (1.1 m ³ /min.)
Recommended Air Supply:			
@100 psi (7.0kg/cm ²)	340 CFM (9.6 m ³ /min.)	108 CFM (3.0 m ³ /min.)	58 CFM (1.6 m ³ /min.)
Shipping Weight:	860 lbs. (387 kg)	255 lbs. (115.7 kg)	255 lbs. (115.7 kg)



Small Gun Assembly with optional outside corner, inside corner and uneven surface brushes. Supplied with suction gun as standard equipment with PRAM 41; also available with 1/4" venturi nozzle as part of the optional small gun conversion kit for the PRAM 45, giving it the same maneuverability and versatility of the smaller PRAM 41. The complete Small Gun Conversion Kit. Stock No. 164-006, includes: Blast gun with 1/4" tungsten carbide nozzle, 20 feet of 1/2 inch media hose, 20 feet of 2 inch vacuum hose, tapering to 1-1/2 inch; and 20 feet of twin line control cable with fittings.

In accordance with our policy of continual product improvement, changes in features, standard equipment, and specifications may be made at any time.

Distributed by:

PAULI & GRIFFIN

Pauli & Griffin Company
907 Cotting Lane,
Vacaville, California 95688 USA
(707) 447-7000 • Telex: 176328



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The PRAM Series
Plastic Reclaimable
Abrasive Machines

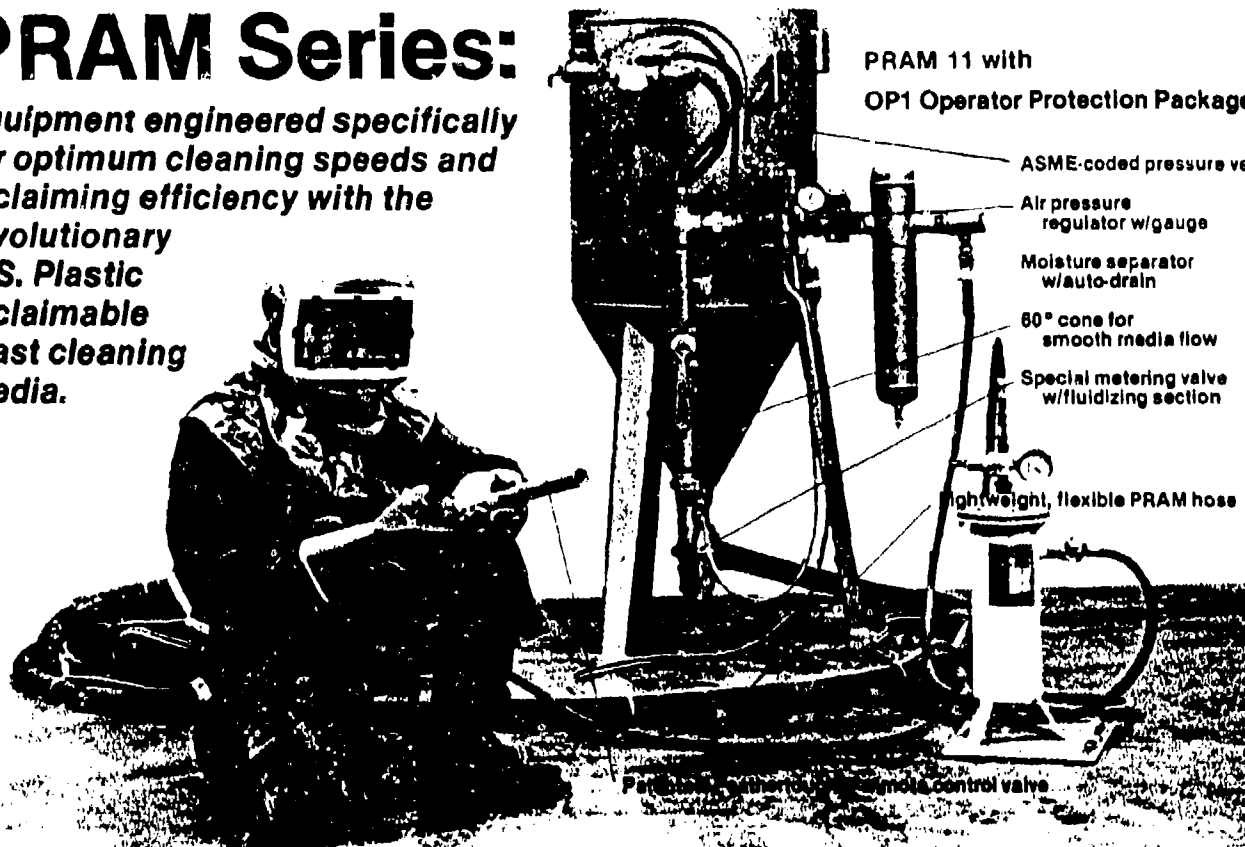


PAUL HARTMAN

Aeronautical Products Division

The PAULI & GRIFFIN PRAM Series:

Equipment engineered specifically for optimum cleaning speeds and reclaiming efficiency with the revolutionary U.S. Plastic reclaimable blast cleaning media.



PRAM 11 with
OP1 Operator Protection Package

ASME-coded pressure vessel

Air pressure
regulator w/gauge

Moisture separator
w/auto-drain

60° cone for
smooth media flow

Special metering valve
w/fluidizing section

Lightweight, flexible PRAM hose

Patented Feather-touch remote control valve

PRAM Portable Blasting Machines

Pauli & Griffin's PRAM Series blast cleaning machines are specially designed to yield optimum production with this light plastic blast cleaning media. Several machines are available, each built to the same standards that have made P&G machines an industry leader for more than 40 years.

P&G's Aeronautical Products Division is taking this leadership to new dimensions, with PRAM Series systems already established as the choice for the first four major cleaning projects using U.S. Plastic Blast Cleaning Media.

PRAM machines are supplied complete with integrated accessories, ready to give you the fastest cleaning performance already proven in field tests.

Features and Components

PRAM 11 Package

- 6 ft.³ capacity ASME coded pressure vessel.
- 60° conical bottom for total media flow, down to the last pound.
- Specialized fluidizing section for smooth, even flow of media.
- Metering valve with exclusive straight through flow design, featuring two horizontal stainless steel discs for precise control of media flow into the cleaning stream.
- Threadless cleanout for fast, easy access to valve interior without any tools.
- Air inlet control assembly, including high efficiency moisture separator plus pressure regulator and gauge for setting and maintaining pressure at recommended 40 psi.
- RC150P remote control system with patented Feather-touch® non-bleeding valve for fast, safe operator control at the nozzle.
- Patented self-cleaning media trap to protect exhaust valve.

- High volume 1 1/4 in. internal and external piping.
- Special lightweight, flexible, long-lasting, abrasive-duty PRAM hose: 1 1/4 in. I.D. and only 1 1/4 in. O.D. — the easiest to handle hose on the market today.
- P&G BMLV-8, Blue Magic™ tungsten carbide, 1/2 in. orifice, long-venturi nozzle for greatly increased velocity and impact of media, and the fastest cleaning possible.

PRAM 12 Package

The P&G PRAM 12 package features a 3 ft.³ vessel, equipped identically to the PRAM 11.

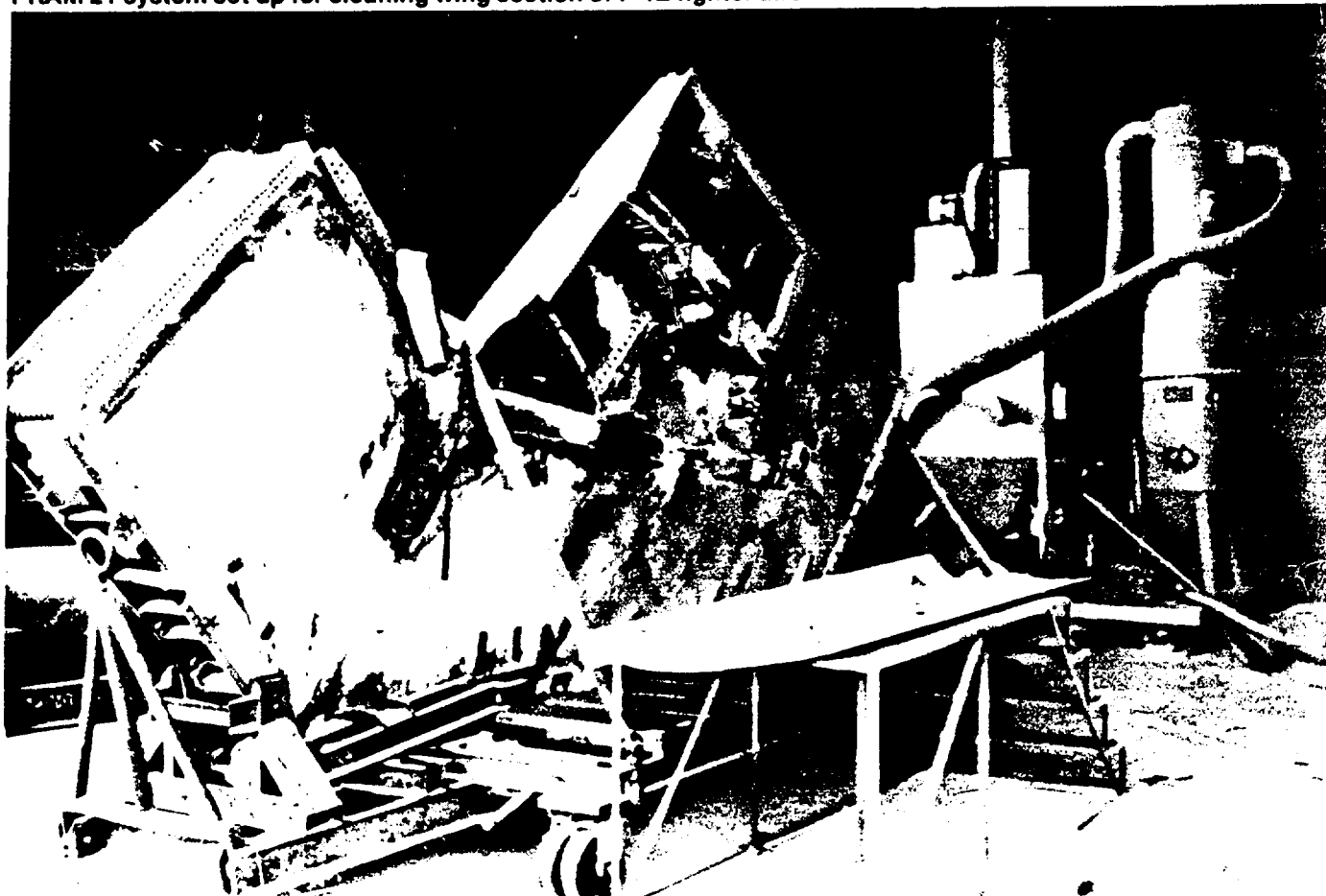
PRAM 13 Package

The PRAM 13 Package features a small, 1 1/2 ft.³ capacity machine that offers easy portability for demonstrations, testing surface conditions, or for small jobs. It has 1 in. piping and remote control valves, and is supplied with 50 ft. of 1 in. PRAM hose, plus BMLV-6, 1/4 in. long-venturi, tungsten carbide nozzle. All other features and components are identical to the PRAM 11 and 12 packages.

PRAM OP1 Operator Protection Package

Complete package is designed for operator protection against dust and rebounding media. Components include:

- MSHA/NIOSH approved air supplied helmet with approved air supply hose.
- Model 903 breathing air filter with replaceable seven stage filter.
- Tee, valve, and hose assembly for connecting air filter to air supply at PRAM machine inlet.
- Chrome leather protective clothing, including gloves, jacket, and split leg apron.



PRAM 21 Portable Cleaning and Reclaiming System

The U.S. Plastic blast cleaning media is highly reclaimable and recyclable when used at recommended 40 PSI. Field tests show that less than 5% of the media is lost per hour when blasting under most conditions. The PRAM 21 Portable Reclaiming System is designed to allow continual reuse of the media, and consists of PRAM 11 machine, a cyclone reclaimer, and a 495 CFM dust collector, all mounted on a wheeled frame for easy mobility at the job site.

Principle of Operation.

A 24 in. x 24 in. loading hopper can be located anywhere within 100 feet of the reclaimer inlet. As the media is loaded into the hopper, the reclaiming system, powered by a 7½ HP motor with high static blower, pneumatically conveys it to a cyclone separator designed especially for the density of this plastic media. The controlled cyclonic action separates the plastic media and heavy debris from the dust and other fines. A finetunable air wash system brings air into the cyclone to improve the separation of fines from the media. The dust and fines are pulled from the center of the cyclone and pneumatically conveyed to a high efficiency dust collector with tubular dust bags. The bags filter all dust down to 1 micron, so only clean air is exhausted into the atmosphere.

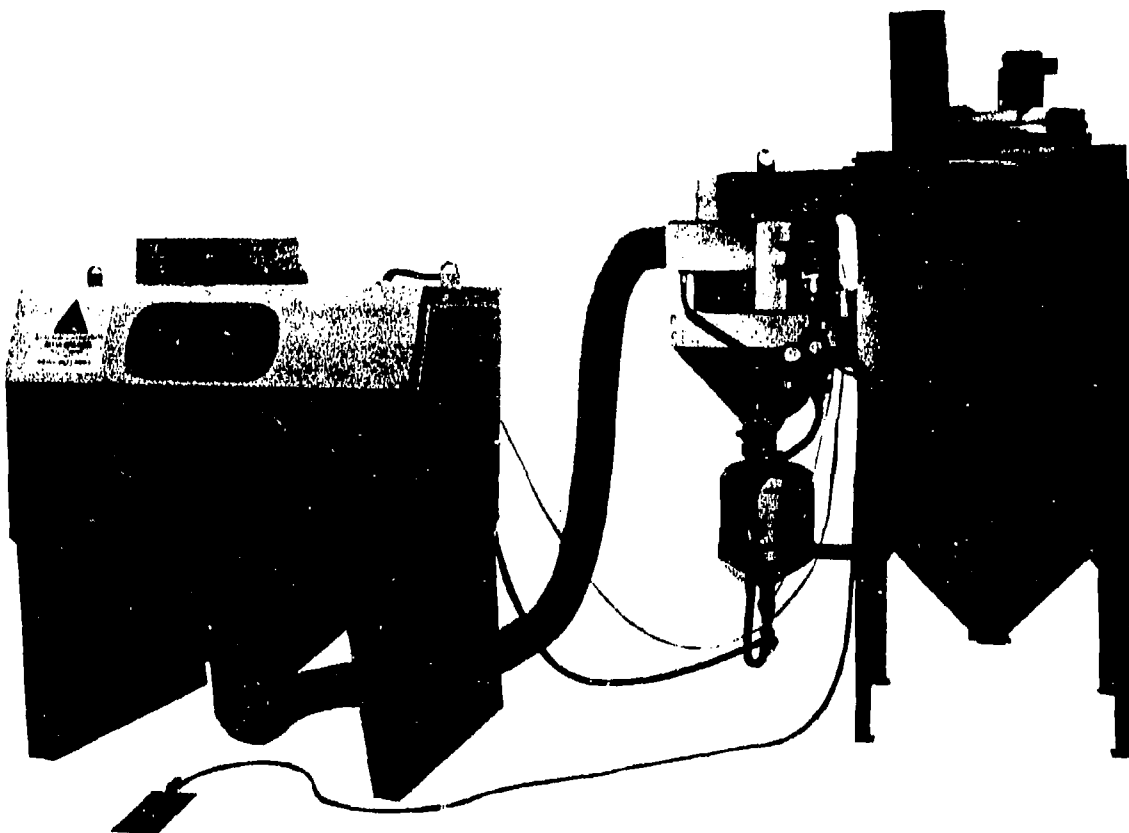
Meanwhile, media and heavy debris fall to a vibrating screen, which contains the debris, and allows only reusable, correctly sized media to fall through to the storage hopper, located over the PRAM machine.

Each time the operator stops blasting, the remote control valves automatically depressurize the machine, and the reclaimed media falls from the storage hopper to refill the PRAM cleaning machine.

System Components

The Pauli & Griffin Portable Reclaiming System includes:

- PRAM 11 blasting machine, 6 ft.³ pressure vessel, with RC150P remote control system, 60° conical bottom, special metering valve and fluidizing section, moisture separator, pressure regulator and gauge at inlet. See page 6 for detailed specifications.
- 495 CFM cyclone reclaimer with vibrating screen plus four air valves and internally adjustable cones — a fine tunable two stage air wash system.
- 495 CFM dust collector with 7½ HP TEFC motor and high static blower; side mounted hose storage rack.
- Removable loading hopper with 25 ft. of 4 in. I.D. reinforced vacuum hose (Up to 100 ft. of 4 in. I.D. hose may be used).
- Wheeled mounting frame of channel steel, 6 ft. x 7½ ft., with four 16 in. 16 x 400 zero pressure tires at one end and two 8 in. swivel wheels with brakes and towbar at other end.



PRAM 31 Blast Cabinet

The P&G PRAM 31 Blast Cleaning Cabinet is a complete, self contained, dust-free cleaning system designed specifically for cleaning parts with U.S. Plastic Blast Cleaning Media. Like the PRAM 21 Portable Reclaiming System, the PRAM 31 offers the combined benefits of direct pressure blasting and finely tuned media cleaning and reclaiming, plus offers a totally enclosed, tightly sealed 60 in. x 48 in. blast chamber.

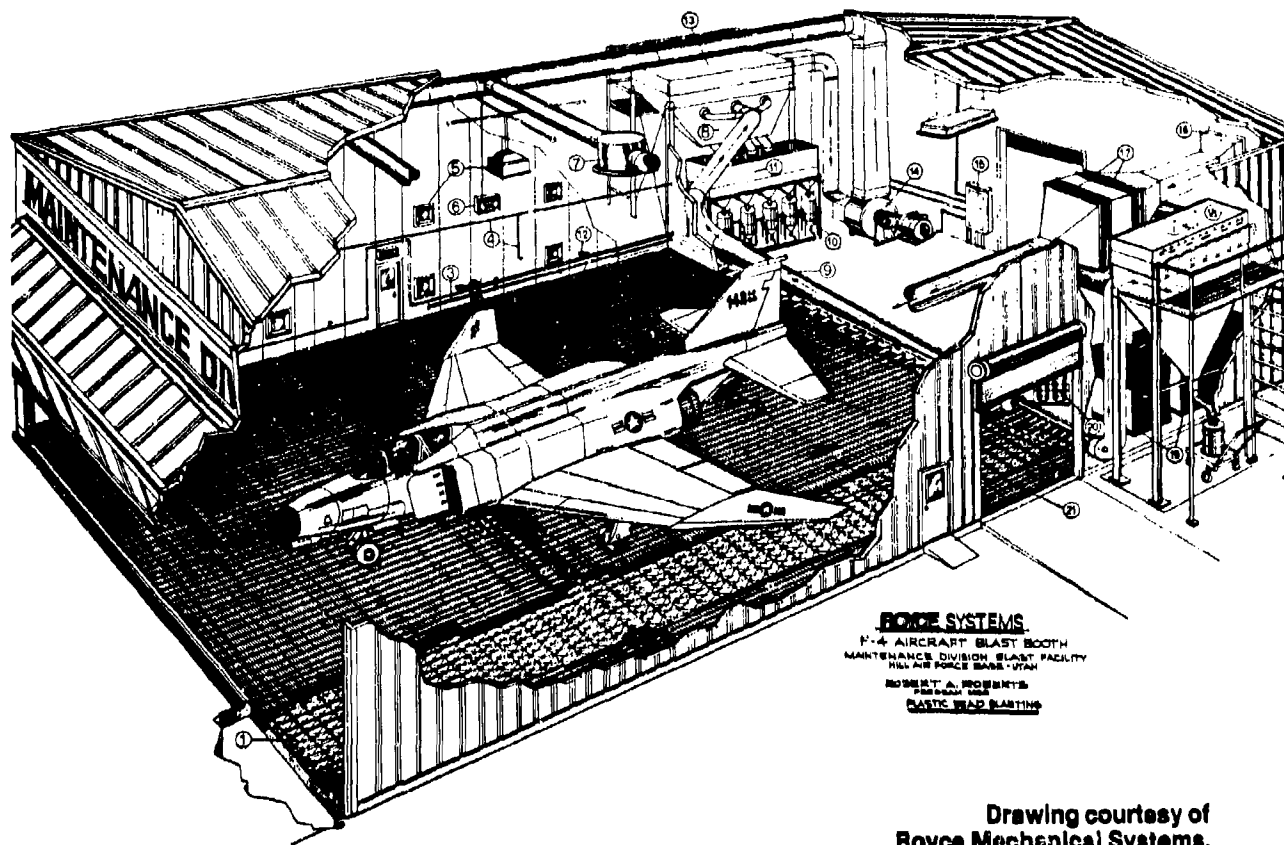
Principle of operation

The blast cleaning operation is accomplished within a large chamber, controlled by an operator working outside, protected from media and dust. Cleaning media is directed through and accelerated by a venturi nozzle. After striking work surface, the media falls to the bottom of the tapered cabinet hopper, from which it is pneumatically conveyed along with dust and debris, to the cyclone reclaiming. There the same cleaning and refining operation as described with the PRAM 21 is accomplished. Clean, correctly sized media falls through the vibrating screen to a storage hopper over the 1 ft.³ pressure vessel.

Each time cleaning is stopped, the PRAM vessel depressurizes, allowing the reclaimed media to refill the PRAM cleaning machine.

System components

- Sealed cabinet with 60 in. W x 48 in. D x 36 in. H work area, illuminated by two 150 watt lights, with a 10½ in. x 22 in. sealed safety view window; ½ in. tungsten carbide venturi nozzle; gloves and gauntlets; foot-operated blast control valve and air blow-off nozzle, 1 in. I.D. piping, valves, and PRAM hose.
- 1 ft.³ pressure vessel with aeration system and 60° cone, remote control inlet and exhaust valves, pressure regulator and gauge, and moisture separator.
- 840 CFM cyclone reclaiming with vibrating screen, mounted over storage hopper.
- 840 CFM dust collector, powered by 2 HP, 230/460 volt, 3-phase motor.



Drawing courtesy of
Royce Mechanical Systems,
Ogden, Utah

A New Media

The revolutionary U.S. Plastic Blast Cleaning Media has proven it will aggressively remove paint, sealant, and coatings from aircraft and other aluminum surfaces without damaging the surface being cleaned. The U.S. Plastic media also cleans seven times faster, in terms of labor hours expended, than conventional chemical stripping, and eliminates the serious toxic waste disposal problem of the chemicals and water used for stripping.

Aircraft paint removal

At a recent demonstration at Hill AFB in Ogden, Utah, a single nozzle P&G PRAM Blast Machine cleaned more than 50% of an F-4E (#68-0345) fighter aircraft in 9 hours of nozzle time. Because the P&G PRAM machine was specially designed for this new U.S. Plastic media, it easily out-performed three rivals; in fact, the P&G PRAM Machine cleaned more surface than all three competitors combined.

Obsoletes Chemical Stripping

Traditional chemical stripping of an F-4E aircraft takes over 390 hours, and generates over 20,000 gallons of contaminated water. Additionally, the chemical stripping process involves mechanical scraping, which damages the aluminum substrate.

Further advantages of the plastic media include:

- Higher degree of consistency and conformity of the media over traditional, soft, agricultural media.
- Extremely low breakdown rate (most field tests show a nominal 1 to 5% media loss per hour).
- Reduced air consumption at lower blast pressure.
- Precise control over amount of paint, number of layers, etc. removed from the surface.

For additional information on this revolutionary blast cleaning media, contact:

U.S. Plastic and Chemical Corporation
328 Kennedy Drive
Putnam, Connecticut 06260
Telephone: (203) 928-2707
Toll Free: (800) 243-1042.
or call Paul & Griffin Company
(707) 447-7000, Telex: 176328

Specifications and ordering information

PRAM Portable Machines:

Model:	PRAM 11	PRAM 12	PRAM 13
Stock No.:	824-099	816-099	814-099
Diameter:	24 in. (61 cm)	16 in. (41 cm)	14 in. (36 cm)
Height:	61 1/2 in. (156 cm)	55 1/2 in. (141 cm)	45 in. (114 cm)
Weight:	365 lbs (174.6 kg)	275 lbs (127.4 kg)	185 lbs (83.9 kg)
Piping:	1 1/4 in. (32 mm)	1 1/4 in. (32 mm)	1 in. (25 mm)
Capacity:	6 ft. ³ (0.17 m ³)	3 ft. ³ (0.08 m ³)	1.5 ft. ³ (0.04 m ³)
Remote Controls:	RC150P	RC150P	RC100P
Nozzle:	BMLV-8, 1/2 in. (13 mm) Venturi	BMLV-8, 1/2 in. (13 mm) Venturi	BMLV-6, 3/8 in. (10 mm) Venturi
P&G PRAM Super-Flex™ Hose, coupled:	50 ft. x 1 1/4 in. ID x 1 1/4 in. OD (15.2 m x 32 mm x 48 mm)	50 ft. x 1 1/4 in. ID x 1 1/4 in. OD (15.2 m x 32 mm x 48 mm)	50 ft. x 1 in. ID x 1 1/2 in. OD (15.2 m x 25 mm x 38 mm)
Control Line:	55 ft. (16.8 m) Twin Line Polyalrcable with fittings		

OP1 Operator Protection Package:

Stock No.:	164-015
Helmet:	P & G No. 907 air supplied helmet w/50 ft. hose & hardware
Air Filter:	P&G No. 903 w/1 outlet, tee, valve, and hose assembly
Clothing:	Chrome leather outfit with gloves, jacket, & split leg apron

PRAM 21 Portable Cleaning and Reclaiming System:

Stock Number:	040-179
Overall Dimensions:	72 in. wide x 90 in. long x 146 in. high (183 cm x 229 cm x 371 cm) NOTE: Muffler (supplied) adds 36 in. (91 cm) to overall height
Reclaimer:	73 in. high (185 cm)
PRAM Machine:	61 1/2 in. high x 24 in. diameter (156 cm x 61 cm) with 60° cone and fluidizing section
Pick Up Hopper:	24 in. wide x 24 in. deep x 25 1/2 in. high (61 cm x 61 cm x 65 cm)
Dust Collector:	36 in. wide x 36 in. deep x 124 in. high (92 cm x 92 cm x 315 cm)
Conveying Rate:	495 CFM (14 m ³ /minute)
Tubular Dust Filter Bags:	30; 140 ft. ² (13 m ²) filter area
Motor:	TEFC 7 1/2 hp, 3450 rpm, 3 phase, 60 Hz, 22 amps @ 230v, 110 amps @ 440v
Conveying Hose:	25 ft. x 4 in. ID (7.6 m x 10 cm) reinforced vacuum hose
Exhaust Hose:	7 ft. x 5 in. ID (2.1 m x 13 cm) flexible exhaust hose
Shipping Weight:	3990 lbs (1810 kg)
Accessories:	As specified for PRAM 11

PRAM 31 Cabinet:

Stock Number:	040-186
Cabinet:	60 in. wide x 96 in. high x 48 in. deep (152 cm x 244 cm x 122 cm)
Work Area:	60 in. wide x 36 in. high x 48 in. deep (152 cm x 91 cm x 122 cm)
Door Opening:	42 in. wide x 31 in. high (101 cm x 79 cm)
Dust Collector:	39 in. wide x 102 in. high x 39 in. deep (99 cm x 260 cm x 99 cm)
Ventilation Rate:	840 CFM (23.8 m ³ /min.)
Tubular Dust Filter Bags:	30; 140 ft. ² (13 m ²) filter area
Motor:	2 HP, 60 Hz, 3 ph, 230/460 v
Pressure Vessel:	1 ft. ³ capacity (0.03 m ³) ASME Coded, with 60° cone and fluidizing section
Blast Hose:	1 in. ID (25 mm)
Conveying Hose:	6 in. ID x 15 ft. (152 mm x 4.6m) reinforced vacuum hose
Nozzle:	3/8 in. (10 mm) orifice, tungsten carbide, venturi design
View Window:	10 1/2 in. x 22 in. (27 cm x 56 cm)
Lights:	Two 150 Watt incandescent lamps
Shipping Weight:	1500 lbs (675 kg)

In accordance with our policy of continual product improvement, changes in features, standard equipment, and specifications may be made at any time.

Distributed by:

PAULI & GRIFFIN

Paul & Griffin Company
907 Cotting Lane,

Vacaville, California 95688 USA
(707) 447-7000 • Telex: 176328





SCHMIDT MFG., INC.
P.O. Box 37, Fresno, Texas 77545
11927 Hwy. 6, Houston, Texas 77045
713/431-0581
800/231-2085

September 30, 1985

Dr. Brian Higgins, PHD, C.E.
c/o Peer Consulting
1160 Rockville Pike
Suite 202
Rockville, MD. 20882

Dr. Higgins:

Thank you for your interest in our Plastic Blast Media System-Blast N' Vac (PMB-BV). The use of plastic media blasting to remove paint has developed a great deal of interest recently because of the adverse environmental effects of chemical paint stripping. Plastic media blasting has generally been found to be capable of removing paint without damaging the substrate, and it is therefore a viable substitute for chemical stripping in all of the applications that we have investigated thus far.

The Advantages of Plastic Media Blasting

The currently accepted practice is to use sand blasting (or other mineral abrasive) to remove paint whenever the substrate is of sufficient hardness that it will not be damaged by such an aggressive media. To strip softer substrates, or substrates that must not receive an etch (anchor pattern) the normal practice has been to remove the paint manually using chemical paint strippers or sandpaper. Since the introduction of plastic media it has now become possible to formulate media soft enough that it does not damage some of the softer materials such as aluminum, magnesium, steel sheet, fiber composites, etc. Plastic media blasting tests conducted at Hill A.F.B., Corpus Christi Army Depot, and Safe Strip of San Jose, California have shown that paint can be removed from these surfaces much quicker than with the laborious methods that have been used in the past. The labor savings using plastic media blasting normally reduce the cost of paint removal to a fraction of what it was using the alternative methods.

The Disadvantages of Plastic Media Blasting

The disadvantages of plastic media blasting:

- The dust produced by the blasting operation must be contained. Subsequent disposal is normally not a problem because the plastic media is inert and non-hazardous.
- The cost of the plastic media is high. This disadvantage can be mitigated by the fact that it can be re-used several times provided the blasting equipment provides for this feature.

* DOD DOES NOT AGREE WITH THIS STATEMENT (R. Boubel, DELP, November 18, 1985)

- . A ventilated blast room with a reclaim floor eliminates the above mentioned disadvantages; however, the cost for such a facility is high and the lead time is usually a matter of years. Its flexibility is also limited by the fact that blasting can only be done at one location and the size of the work is limited by the size of the room.
- . The blasting operation will be uncomfortable unless protected from the dusty environment by using an air-fed blasting hood.
- * . The plastic is flammable, so an accumulation of dust can produce an explosion hazard similar to a grain dust or coal dust explosion hazard. *

The Disadvantages of Chemical Stripping:

- . The chemicals are expensive.
- . The chemicals and contaminated dillution water are expensive to dispose of (legally).
- . It is labor-intensive and therefore costly.
- . The chemicals are toxic and therefore damaging to the environment.
- . The chemicals are destructive to the facility in which they are used, corroding steel structures, dissolving concrete floors, and damaging equipment.
- . The chemicals are hazardous to humans. Some have been found to be carcinogenic, and the acids (both paint removers and etchants) can cause acid burns, respiratory damage, and vision loss.
- . Stripping of aircraft paint and coating systems with chemicals presents the hazard of interior seepage, therefore causing possible wiring and instrumentation damage which could result in a fire during flight.

The Schmidt PMB-BV

- . The PMB-BV removes paint with a standard plastic media blast nozzle that is enclosed by a vacuum shroud that immediately re-captures the blast media, blast media dust, and paint dust. It acts as a localized blast enclosure and does not allow the media and dust to be released to the environment.
- . The shroud has the added benefit that it dampens the blasting noise greatly reducing the noise exposure to the operator.
- . By containing the media, dust, and noise inside the vacuum shroud the immediate working environment is so much improved that the operator does not need to be encumbered with any special protective clothing or blast hood.
- . It can be used in almost any location without inconveniencing other workmen who may be masking, painting or carrying

on a conversation right next to him. It allows an inspector or supervisor to closely monitor the work in progress without subjecting himself to the noise, particle ricochet, and dust of a blast room environment.

- . The flammable dust explosion hazard is controlled by containing all of the flammable dust in a dust filter and cyclone that is designed to contain the explosion pressure if an explosion should occur.
- . The PMB-BV is designed as an integrated unit so that no external handling of the dust or media is necessary, thereby minimizing dust loss to the atmosphere.
- . The paint and media dust is removed from the unit as a water slurry, again minimizing dust loss to the atmosphere. The slurry can be dried easily if disposal as a slurry is undesirable.
- . The PMB-BV offers variable control capabilities in both the blast and media recovery (vacuum) operations enabling sufficient control to allow the stripping of materials ranging from fiberglass to titanium without danger of substrate skin deformation when used properly.

Further Detailed Information on the PMB-BV

This system is capable of removing surface coatings from surfaces such as 2024 alclad aluminum (T-3), 7075 anodized aluminum (T-6), aluminum skins/components, aluminum skinned/honeycomb, magnesium skins/components, fiberglass composites/advanced composites, engineered plastics, steel, stainless steel, kevlar, and titanium.

The PMB-BV is a closed cycle blast and simultaneous recovery system, for use with Plastic Blast Media. The system incorporates a standard long venturi blast nozzle which is surrounded by a "Blast N Vac" vacuum head; this head is used for recovery of dust, abrasive and paint residue at the point of blasting. This provides total visibility and dust free blasting both at the point of blast and at the recovery system. The plastic media is recycled within the system, cleaned, and residue separated for disposal.

This aircraft paint stripper can be used with a variety of plastic materials, US Technology Corporation has been a main source of supply. The media is available in three grades with hardness (Moh) of 3, 3.5 and 4.

The PMB-BV system operates with a wide range of pressures from 2 psi to 100 psi. This capability makes paint removal from substrates possible without damage to the substrate.

These substrates include aluminum, composites, fiberglass and other skins and soft metals. Because the material is recovered at the

blast nozzle, dust and flying media is eliminated. This system is also beneficial for use in close proximity to other work and equipment during spot repairs. Improved visibility and environment greatly enhance safety and operator comfort. This closed cycle system provides for automatic media recycle greatly reducing material contamination and loss.

The production rate/speed is a function of type of media, hardness of media, blasting pressure, substrates, type of coating and thickness of the coating. Typical production with #4 nozzle ranges from 1 to 3 square ft. per minute; however increase nozzle size within the same head can substantially increase production rate. The nozzle is held perpendicular to the work piece and the distance from the nozzle to the work piece remains constant with increase or decrease in the pressure becoming the variable.

It is supplied with 25 ft. of light weight blast hose and 25 ft. flexible vacuum hose. The PMB-BV blast and vacuum hose can reach up to 100 ft. from the machine. It is capable of loading, re-covering, reclaiming, cleaning and recycling the plastic media and capturing the dust for disposal. It incorporates a cyclone separator with screen separation. It has a liquid coalescing dust removal filter system, liquid level indicator and is explosion safe construction. It is mounted on a hand trailer or skid mount. The trailer design is castor and dolly and has "zero" turn radius for one man operation. It also has fork lift pockets and a lifting eye and can be towed with minor modifications at low speeds. The unit is 7 ft. high by 7 ft. long and 5 ft. wide; its weight is 1200 pounds.

The pressure vessel is built to ASME Code Section VIII, division 1 specifications, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The blasting vessel is equipped with a 60° cone bottom, automatic pneumatic vibrator and air fluidization system which insures proper plastic abrasive flow. It incorporates 149 Thompson automatic control valve and deadman controls. In this normally closed system the media valve is opened and shut each time the deadman valve is activated; this eliminates any material build-up in the blast hose when blasting stops. In a normally open system, where the media valve does not open and close each time the deadman is turned on and off, there is excessive media build-up in the blast hose which causes surging and slugging; this is time consuming and uses excessive abrasive. This normally closed system also eliminates excessive moisture accumulation found in systems that depressurize the vessel each time the deadman is activated.

Price are FOB Houston, Texas. Approximate delivery two weeks.

Pneumatic	\$13,300.00		
Electric	\$17,100.00	(single phase)	\$16,800.00 (three phase)
Combination pneumatic/ electric	\$18,100.00	(single phase)	\$17,800.00 (three phase)

Thanks again for your interest.

Very truly yours,

Marshall J. Seavey / js

Marshall J. Seavey
V.P. Marketing

MJS:js